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CONTENTS.

An Asterisk (*) Denotes an Illustrated Article.

OFFICIAL NOTICES—
- January Meeting, New York Section, Illuminating Engineering Society..... 97
- Annual Meeting, Indiana Gas Association..... 97
- Annual Meeting, Southern Gas Association..... 97
- Wrinkle Department, American Gas Institute..... 97

SPECIAL OFFICIAL NOTICE—
- Bureau of Information, American Gas Institute..... 97

EDITORIALS—
- Briefly Told..... 97

Current Mention.
- *Some Quantities Anent the Late Gas Show..... 98
- *Practical Demonstrations of the Gas Arc Lamp, by "Inspector". 99
- Report of Proceedings, Fourth Annual Meeting, American Gas Institute—Continued from page 53..... 99

First Day, Morning Session—*Report of Committee on Industrial Gas Appliances—Exhibit A.—Specifications for Gas Ranges—B. 1910 Specification for Gas Range—C. 1910 Water Heater Specifications—D. Water Heat Specifications—Wrinkle Department—*Report of Committee on Calorimetry—The Year's Investigation—Thermometers—Arrangement of Apparatus for Tests—Water Supply—Investigation of Variation in Heating Value, Etc.—Thermal Balance of Tests in Series "C."—Heat Absorbed or Radiated by the Calorimeter—Etc.

- *The Krause Plan of Quenching Incandescent Gas Coke..... 109
- Meeting Times of the Various Gas Associations..... 109
- Recent Patent Issues..... 110

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 110

Annual Meeting, Beatrice, Neb.—A Great Many Read Mr. Lea's Shingle—Three Personals—Coast Representation—A Contract Completed, Gas Machinery Company—The Brandon (B. C.) New Gas Works—A Big Power Plant on the Coast—The New Jersey Suburban Gas Company—Annual Meeting. St. Albans, Vt.—The Massachusetts Board Makes Some Recommendations—Three More Personals—Contract for the Cruse-Kemper Company—Death of Mr. J. F. Klug—Mr. Slimpin Packed His Bag—Death of Mr. Godfrey Patterson—Wedding Bells—Gas Supply for Atlantic Highlands, N. J.—Death of Mr. L. Woodward—Betterments on the Shenandoah (Ia.) Plant—And Other Items.

- Illumination Glare..... 111
- The Market for Gas Securities..... 112

[OFFICIAL NOTICE.]

January Meeting, New York Section Illuminating Engineering Society.

ILLUMINATING ENGINEERING SOCIETY, N. Y. SECTION,
OFFICE OF THE SECRETARY,
NEW YORK CITY, Dec. 31, 1909.

Gentlemen: The regular meeting of the New York Section of the Illuminating Engineering Society for the month of January will be held the evening of Thursday, the 20th, at 8:15 P.M., in the building of the Engineering Societies, 29 West 39th street. Kindly note that this meeting will be held on the third *Thursday* of the month, instead of the *second Thursday*, as is the usual custom. The papers of the evening will be on: "Bowling Alley Lighting," by Mr. Thomas W. Ralph; and "Selling Electric Light," by Mr. T. I. Jones. Both papers will probably be illustrated by stereopticon views.

Respectfully yours, A. J. MARSHALL, Secretary.

[OFFICIAL NOTICE.]

Annual Meeting, Indiana Gas Association.

INDIANA GAS ASSOCIATION, OFFICE OF SECRETARY,
INDIANAPOLIS, IND., Dec. 30, 1909.

To the Members, Indiana Gas Association: The annual meeting of the Indiana Gas Association will be held in Indianapolis, the 19th and 20th insts. Details will be given later.—PHILMER EVES, Sec'y.

[OFFICIAL NOTICE.]

Annual Meeting, Southern Gas Association.

SOUTHERN GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
ROME, GA., Jan. 10, 1910.

To the Members, Southern Gas Association: The Annual Meeting of the Southern Gas Association will be held in Chattanooga, Tenn., February 16th, 17th and 18th, next. Headquarters, Hotel Patten. Further information will be given later. Respectfully,

JAMES FERRIER, Secretary.

[OFFICIAL NOTICE.]

Wrinkle Department, American Gas Institute.

WRINKLE DEPARTMENT, AMERICAN GAS INSTITUTE,
OFFICE OF EDITOR, ELECTRIC AND GAS BUILDING,
ATLANTA, GA., Jan. 10, 1910.

To the Members of the American Gas Institue: Please forward contributions for the Wrinkle Department to the above address. I would suggest that each manager address a letter of solicitation to the head of each department of his Company. Kindly assist me in this work I have undertaken, and greatly oblige, Very respectfully yours,

R. C. CONGDON, Editor.

[SPECIAL OFFICIAL NOTICE.]

Bureau of Information, American Gas Institute.

DETROIT CITY GAS COMPANY,
ENGINEERING DEPARTMENT,
DETROIT, MICH., Nov. 26th, 1909.

To the Members, American Gas Institute: Send questions to be submitted to the Bureau of Information for answer to V. F. Dewey, Chairman, Gas Office Building, Detroit, Mich. The Bureau of Information respectfully solicits your troubles. Yours respectfully,

V. F. DEWEY, Chairman.

BRIEFLY TOLD.

CURRENT MENTION.—

THE gas fraternity of New England and the Middle States might do well to look out for the "advent in their midst" of a chap who seems to have a different name in each center of population which he visits. "Brady" looks the name most frequently used. His visiting system is a house-to-house canvass, offering for sale a gas burner which he "guarantees" will cut down the consumption (average) in any household at least 50 per cent. His course was temporarily stayed, towards the close of the first week in January, at the instance of the Cambridge (Mass.) Gas Light Company, who had him "jugged" for peddling without a license.

MR. O. M. DIALL, General Manager of the Lockport (N. Y.) Gas Company, has been appointed General Manager of the Gas Lighting, Power and Street Railway Company, of Elmira, N. Y. The change will become effective April 1st.

MISS EFFIE NELSON has resigned the position of bookkeeper of the Dekalb (Ills.) Gas Company.

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SMITHSONIAN DEPOSIT.

Some Quantities Anent the Late Gas Show.

Men of letters, as well as the raconteur, engage us with their twice-told tales, so that "The Gas Show Revisited" might be a permissible title for this offering. It would seem almost puerile to add that the importance of such events is best judged in retrospect, and that this "greatest aggregation ever exhibited" far outshone its laudatory prospectus.

The show was open for one week, the first two days for the private inspection of the members of the National Commercial Gas Association, the remaining five for the public. During these five days no less than 75,000 persons visited the show, and undoubtedly enjoyed the exhibits.

The matter of piping has been previously referred to, and that it rights. The Humphrey lamps, in the foreground, consisted of 6 clusters of 13 lamps down the center, and 28 clusters of 5 lamps over the main auditorium. These fixtures were designed and made by the General Gas Light Company, under the direct personal supervision of Messrs. A. H. Humphrey, J. P. Conroy and J. M. Coles.

The Welsbach Reflexoliers will be noted in the arches around the balconies, and some 500 lamps were so employed. The Junior lamps were used in art glass globes surmounting the posts around the edge of the balconies. These lamps were installed under the supervision of Messrs. Stites, Chapin and Wardell of the Welsbach Company.

Both the thanks and the appreciation of everyone concerned are due to these two great lamp companies for their efforts toward making the show a success.

was a task of no small proportions would seem to be borne out by the quantities of pipe used (over 2 miles), by sizes as follows:

4-Inch.	3-Inch.	2-Inch.	1¼-Inch.	1-Inch.	Total.
450	870	4,000	5,000	1,100	11,420

The maximum quantity of gas sent into the Garden was between 12,000 and 13,000 cubic feet per hour. Roughly speaking, about one-half of the gas consumed was employed for the illumination of the Garden, and the fact that no local lighting was necessary will not be surprising when it is considered that well over 100,000-candle power (M.S.C.P.), or 1¼ million lumens, were being sent forth.

The above illustration was timed to show the lamps and fixtures employed, rather than to in any sense depict the beautifully effective illumination obtained, and the arrangement of large units for the general lighting and the smaller units for decorative effect was most successfully carried out. Only three types of lamps were used, Humphey 5-burner arcs, Welsbach Reflex inverted and Junior up-

Some small measure of the successful illumination of the great amphitheater may be judged from the fact that praise in great abundance has been meted thereto and further, by the fact that those who in the past have left no stone unturned, from carping to defamation, to besmirch the fair name and fame of gas lighting, have in this instance been shamed to silence. In fact, at the last meeting of the New York Electrical Society the speaker of the evening dwelt upon the beautiful lighting effects obtained.

The January number of the *Illuminating Engineer* states that, "While the hall is brilliantly illuminated, there is no undue strain upon the eyes; and particularly impressive is the daylight quality of the light."

Many similar expressions of approval could be quoted, but the significant feature lies in the fact that the press and the public have been given an object lesson which places gas lighting before their eyes as one of the greatest of the modern illuminants, a fact known to us as being the greatest of these illuminants.—LUMINO.

Practical Demonstrations of the Gas Arc Light.

By "Inspector."

Demonstrating the practicability of the modern gas arc light for illuminating purposes is now a profession successfully followed by numbers of gas engineers and mechanics who have undertaken to occupy this field; and the field is a very extensive one, usually divided into the following classes, each class of which is engaged in by someone specially experienced in the particular line.

Illumination by gas arcs of stores, offices, fairs, markets and places in general where orders are taken, goods sold and merchandise exhibited for either sale or demonstration. In the second class the application of the gas arc illuminant to household purposes forms another class and includes the installation and lighting of rooms, also, in all apartments of hotels, houses and places where people live, eat, sleep, study, read, sew, etc. The third class includes demonstration by promoters of the usefulness of the gas arc lamp as an illuminant in the field of advertising. This is a special field and is devoted to the expositions of lights as applied to signs on buildings or wherever the gas arcs are employed for advertising purposes.

The fourth class of lighting with the gas arc is that type of light most adaptable to illuminating industrial places, whether interior or exterior. The shop lights are in the same class with the mine illumination. Finally comes the fifth class of gas arc illumination, which includes street lighting.

With the classification of the different forms of lights some have appeared in the field of demonstration who are not only experienced in showing the merits of gas arc illumination for any of the purposes included in the several classes of lights, but men who can talk on the subject. It has been proven that it pays to have experienced lecturers give demonstrations for the public. The plan usually involves the marking-off of sections of States for districts in which various parties may work and advertise the special form of gas arc which is to be put out. The advertising party includes the expert in lighting and lighting fixtures, the lecturer, who is also well up in gas illuminating engineering, and someone to put out advertising matter. A room in a hotel may be secured and the storekeepers and the householders invited to visit these and listen to talks on the advantages of gas arc illumination and to note just how the lights are operated.

Or a vacant store downtown can be rented and used to very good advantage for this purpose. In fact, the store is the best, for there are the counters all in readiness as well as the show window in which the demonstrations can be made. The advanced methods of lighting stores, so as to exhibit the goods and make the show place a pleasant place, are all undertaken for the customer. As soon as arrangements are made for the rental of the room or store, the work of setting up the fixtures begins. This may require several days.

The different types of illuminating lights, as applied to the several purposes, are all arranged for. There is almost always space in which ornamental fixtures may be hung for supporting the lamps with a view of showing how well the fixture looks, as well as how the light can be thrown about the place.

As soon as the fixtures are in order for practical demonstrations the advertising is put out. Circulars can be distributed throughout the city or town, and some advertising should be put in the local press. The newspaper men should be invited to come and see practical experiments with the improved styles of gas arcs, and lists of business men, likely to be interested in gas arc illumination for a store or shop, can be obtained and made up from the city or town directory. Then circulars and letters should be mailed to the parties, inviting them to come and see how the brilliant lights can be obtained at a saving, etc.

Lectures advertised to take place on practical illumination of stores, houses, offices, shops and streets will usually attract enough interested persons to make it an object. Sometimes the lectures are made interesting with lantern slides or moving pictures, illustrating the interior of stores before and after introducing the modern gas arc. Of course, such pictures are taken on a moving picture film by experienced men who go from place to place until they find a dimly lighted store with few customers in it. Then arrangements are made to take the picture. Later on an arrangement is made to get the "after" picture. New gas arc lights are installed and the store is brilliantly lighted. The man at the film machine waits until there is a good rush of patronage, then he runs off a few hundred feet of film showing the crowd. This film is pasted to the end of the other film; therefore,

when the lecturer makes his demonstrations of the before-and-after effect in a store when good lights are installed, the picture machine operator runs the two views, one following the other, to prove just how it happens. It pays to advertise. The storekeepers and the housewives get interested. Some of the gas illuminating firms have accomplished big business in towns by sending a little party of men out to arouse the business men. The practical demonstrations have a telling effect every time.

[Continued from Page 53.]

REPORT OF PROCEEDINGS, FOURTH ANNUAL MEETING, AMERICAN GAS INSTITUTE.

Held in the Hall of Elks, Detroit, Mich., October 20, 21 and 22, 1909.

First Day—Morning Session.

The President—The next is the

Report of the Committee on Utilization of Gas Appliances,

by Mr. W. J. Serrill, Chairman. In the absence of Mr. Serrill Mr. Walton Forstall read the report as follows:

The Committee having been recently appointed, this report is necessarily a preliminary one. Gas consuming appliances, excluding those used to give light, may be divided into three classes:

1. Industrial appliances. 2. Cooking appliances. 3. Water heaters.

(1.) *Industrial Appliances* have had a large development in recent years. Special designs have been made to meet special requirements, until practically all processes in the arts that require heat may be carried on by the use of gas. Obviously, no attempt need be made to standardize the construction of appliances belonging to this class. The extension of the use of these appliances among its consumers should form an important part of the activities of every gas company. The Committee will consider the establishment of a plan by which a knowledge of new appliances designed to meet special needs may be gathered from various sources and furnished to the members of the Institute.

(2.) *Cooking Appliances*—The constructiou of the more usual forms of cooking appliances has become stereotyped in the general features, but still exhibits many variations in details, among the various manufacturers and from season to season. The advantages to both gas company and manufacturer, in the adoption of a standard design, which would be practically unchanged from season to season, are obvious. The objection sometimes raised, that the adoption of a standard will tend to discourage invention or improvement, the Committee does not consider a serious one, believing it will not shut the door to any real improvement. The subject is full of difficulties, owing to the special requirements of different localities, but the Committee will give it serious consideration. As a means of eliciting suggestions, the specifications in use, by two large purchasers of gas ranges, are inclosed as exhibits in this report. The principal points of difference, brought out in those specifications, are:

1. Sheet steel vs. cast iron, front and top.
2. Loose cap vs. 1-piece cored-top burners.
3. Air space vs. sheet asbestos, insulation in ovens at sides and back.
4. Front (open door) vs. side, pilot-lighting for oven burners.
5. Lever handle cocks vs. needle valves.
6. Fixed orifices, drilled in removable spuds, vs. adjustable orifices.

The members are urged to send suggestions on these and other points in the specifications to the Chairman as soon as possible after this meeting.

(3.) *Water Heaters.*—The satisfactory solution of the problem of heating water in dwellings is important, for on it depends to a large degree the extension of gas cooking. The varying requirements of different localities, with different climates, make any uniform solution of this problem a difficult one. One direction in which investigation may prove valuable is in the development of a thermostatic control in the ordinary combination of circulating heater and kitchen tank, so that a certain quantity of hot water is always on hand, and a comparison of the operating cost of such an arrangement with that of the circulating heater and tank without the thermostat, wherein the water is heated only as needed. The specifications of two large users are inclosed as exhibits. Suggestions are solicited.

Respectfully submitted,
W. J. SERRILL,
J. C. D. CLARK,
G. D. ROPER,
W. J. CLARK,
E. G. VAN WIE,
} Committee.

EXHIBIT "A."—SPECIFICATIONS FOR GAS RANGES.

Top Burners.—Drilled burners with raised apertures, loose caps resting on ground surfaces. These surfaces protected from drippings by shed protection on cap on outer edge, and thimble in center cast onto cap, and extended below burner bowl with edge beveled to properly dispose of drippings. Burners to be rigidly supported without bolts or screws, and easily removed.

One giant, 3 regular, 1 simmer burner for stoves with 18-inch ovens; 20 and 22-inch oven stoves, 2 extra regular top burners and 1 extra simmer burner. Burners and valves arranged equidistant.

Valves.—Valves having independent adjustable gas apertures only to be used. To be rigidly braced so they cannot be turned in manifold.

Manifold.—Made-up manifold preferred. If tapped pipe manifold is used, it must be extra heavy and not less than ¾-inch size. Supply pipe for top burners should rise at back of range so as to take their supply before the oven burners. Manifold to be tested at factory and be gas-tight without calking under not less than 10 pounds pressure.

Oven Doors.—Counter-balanced drop-doors, without catch, or spring balanced drop-doors with friction catch. Where steel spring shield is used, same should be not less than 18-gauge.

Ovens.—Insulation not less than ¼ inch dead air space, with corrugated sheet asbestos lining on all sides and back, and next to outer wall of stove. Linings to be secured in position without bolts or screws, and so arranged that they are easily removed. Meat ovens, 12-inch high preferred.

Oven Burners.—Drilled line burners supported without bolts. Mixers which can be removed or opened wide for cleaning, and equipped with shield that can be rigidly set when in use. Simple oven lighting device necessitating opening the oven door for lighting, and oven arranged so that oven burners can be easily seen.

General Construction.—All ranges must be manufacturer's standard type of appliances. In other words, your best. Flue opening in top plate, 4 inches in diameter, fluted and drilled for pin to hold flue pipe. Top grate openings as large as possible, especially from front to rear. Feet of stove detached. Standard 18-inch oven ranges to weigh not less than 160 pounds. Body corners to be braced. One-piece cast base and cast top. All parts to be arranged symmetrically to produce a pleasing, substantial, plain-finished appearance. Nickel plating to be heavily nickeled, and steel parts to be smooth and uniform color. Castings to be smooth and plain, properly proportioned for strength.

EXHIBIT "B."—1910 GAS RANGE SPECIFICATION 1910.

1. *Body.*—The fronts, tops and leg bases of all ranges to be preferably of cast iron; if made of sheet steel, the metal to be not less than No. 18 gauge (U. S. Standard). Ornamentation to be plain and simple. No leg base to extend around the range. Outside sheet of body to be one piece, and to extend from the leg base to the main top. Linings to provide ¼-inch air space insulation to the ovens at sides and back, without asbestos. Linings to be easily removable and to be held in place without bolts or clips. Bolt holes in castings to be circular and not slots. The sub-top or burner-box to be of galvanized sheet steel, or of cast iron; to be turned up to meet the main top, and not to be bolted in place.

2. *Ovens.*—Ovens of single oven ranges to be not less than 11 inches high; a height of 12 inches is preferred. The same rule applies to the baking ovens of double oven and cabinet ranges. The broiling ovens of double oven and cabinet ranges to be not less than 9 inches high.

Ranges which have both ovens elevated and placed over the top burners, to have baking ovens not less than 11 inches (preferably 12) inches high, and broiling ovens with a clear space of not less than 5 inches from the bottom of the broiling burners to the oven floor. Ranges which have only the broiling ovens elevated and placed over the top burners, to have the broiling ovens not less than 9 inches. Auxiliary baking or broiling ovens to be not less than 9 inches high.

3. *Oven Tops.*—The outside part of the tops of baking ovens on elevated and cabinet types of ranges to be preferably of cast iron; if of sheet steel, to be not less than No. 18 gauge (U. S. Standard). The inside part of these tops to follow the regular construction as in ranges where the top burners are over the oven. The tops of separate elevated broiling ovens to be made in two parts. The inside part should be made of not less than No. 18 gauge (U. S. Standard) sheet steel, and perforated to allow the products from the burners to escape through it. The outside part should be made of two pieces not less than ½ inch apart, with a mineral wool or similar insulating material between them. None of this material to be exposed. This material to be tightly enough packed to keep it from shifting and giving an uneven protection. The inside sheet of the outside part to be made of No. 18 gauge sheet steel, while the outside sheet may be either cast iron or not less than No. 18 gauge (U. S. Standard) sheet steel. Cast iron is preferable. This outside part to be bolted together and handled as one piece.

4. *Oven Bottoms.*—In ranges where a broiling oven is located immediately beneath the baking oven, the baking oven bottoms to be double, with insulation between the sheets, of asbestos or similar material. This insulating material not to be exposed. The sheet metal to be used in these bottoms to be not less than No. 18 gauge (U. S. Standard) sheet steel. In ranges where there is no broiling oven immediately beneath the baking oven, the upper part of the baking oven bottom (above the burners) to be of the same construction as just specified; the lower part (under the burners) to be, if next to the floor, of two galvanized steel sheets, separated so as to give air space insulation and so fastened together a s to be handled as one piece, and to slip into place—the temperature, as shown on a blackened bulb thermometer laid on the floor under the range, should not exceed 120° in 40 minutes; if elevated, so made that it is air tight, bolted in place, and of either cast iron or galvanized sheet steel. The bottoms of broiling ovens to be made as just specified for the lower part of baking ovens.

5. *Rack Supports.*—Rack supports to be made of channel construction, to prevent racks from tilting when partially withdrawn; each set of supports preferably to be formed of 1 piece of sheet steel. One support to be placed so that the bottom rack in the baking oven is 1½ inches above the oven bottom; another support to be placed midway between the lower support and the oven top; the other supports to be appropriately spaced. In broiling ovens the supports to as close together as possible throughout the heig ht of the oven.

6. *Sheet Metal.*—No parts made of sheet steel (or iron) to be less than No. 24 gauge (U. S. Standard). Heavier metal to be used where specified. All to be of black, sheet steel, except sub-tops (or burner boxes), range bottoms, drip pans and bottoms of elevated broiling ovens. When the sheet steel is galvanized, the black sheet to be No. 24 gauge before being galvanized. The outside body is the only part of the range which may have a japan finish.

7. *Flues.*—The flue back to be of cast iron. The collar for flue connection to be on the top of the range, and to be so ventilated that the placing of a vessel over the collar will not prevent the oven products from escaping.

8. *Doors.*—Swing doors to be hung on pins, which are set in the door lugs when same are cast; tops of lugs to have a smooth finish. Door catches to be so designed that any pressure on the door from within the oven will cause it to open. Swing doors to have the hinges on the side of the range opposite to the oven burner cocks. Drop doors, when over 6 inches in height, to have a spring or a counterbalance. Baking oven doors either to be insulated or to have a smooth, cast iron inside surface, coated with aluminum paint. Broiling oven doors to be so ventilated as to admit an ample supply of air to the broiling oven, and to make it possible to observe the burner flame through the vent holes.

9. *Legs.*—Legs should raise the lower edge of the leg base at least 2½ inches above the floor; the 4 legs to be interchangeable.

10. *Oven Burner Plates.*—To be made with collar deep enough to

engage the oven lining; lining to be cut to fit the collar neatly. To have a slot where each oven burner enters to engage the rib (or web) on the burner, thus preventing same from being set wrong side up.

11. *Bolts.*—No bolts or screws to be used, except those having standard stove-bolt threads. Door linings, knobs, handles and name plates to be attached by through bolts with nuts, not by rivets. The bolts and nuts holding the nob or handle and name plate on the door to be accessible without the removal of the door lining.

12. *Top Grates.*—Top surface to be raised slightly above the level of the main top; edges to be gradually beveled to where they meet the main top, so that a vessel will slide on or off without jar. Arms to be so spaced as not to come over the gas outlets of top burner. Top grates to be interchangeable, 2 pieces preferred.

13. *Top Side Shells*—To be interchangeable.

14. *Top Burners*—Burners to be cored castings, and not to have any loose parts. This applies to simmering as well as to other burners. The gas outlets to be drilled ports. No cone-spreader to be used. Top burners not to be bolted to their supports, unless the supports lift out with the burners. No supports to be bolted to range. Supports to be interchangeable. The supports to be such as will keep the burners permanently at even distances below the top grates. The distance between the tops of burners and the bottom of a vessel placed on the top grates to be not less than 1¼ inches. The simmering burner to be so located that its combustion will not be hindered by nor interfere with the combustion of any other burner. The simmering burners on cabinet ranges not to be located on same side as ovens.

15. *Oven Burners*—To be easily removable, and not be bolted to or locked into their supports by any means except such as may be necessary to prevent their displacement in shipping. The gas outlets to be drilled ports. Each burner to be constructed with projecting rib at mixer end to engage slot in oven burner plate. Oven burner supports at far end to be of cast iron; to be bolted to rack support, or oven lining, and not to range body. Provision to be made for the observation of the oven burner, in single oven ranges, without opening the oven door. When two or more burners are used on a range, they are to be interchangeable. Separate broiling burners not to be placed in the same oven with the baking burners.

16. *Oven Pilot Lighters*—A type that lights at the side of the range is preferred. The gas is to be fed to the lighter through a separate cock; there is to be a fixed mixer; and the pilot burner is to be a 1-piece, cored, casting, drilled, sawed or milled, so that, when it is lighted, it burns with blue flames. Arms of the pilot burner to reach both of the oven burners, the ports to be so close to ports in the oven burners, and arranged at such an angle, that the lighting is positive, and that the pilot burner will relight from either of the oven burners. The outer end of the pilot burner, whether it is arranged to be lighted from the side or from the front of the range, to project in such a manner, and to have ports so arranged, that when the pilot is burning, the flames in these ports can be plainly seen without stooping. This projecting end to be so distant from the pilot mixer that there is no danger of the pilot lighting back.

17. *Air Mixers*—Air mixers for top and oven burners not to be separate castings, but to be cast with the burners. To have flat faces, machined off and fitted with flat faced, close-fitting shutters, to be attached by $\frac{3}{16}$-inch stove bolts. The shutters themselves to be of substantial cast or malleable iron, or not less than No. 20 gauge (U. S. Standard) sheet steel. Shutters for top burners, and sheet-steel shutters for oven burners, to be nickel plated.

18. *Cocks*—The gas way to the burners to be controlled by quarter-turn cocks, which are to be made strictly in accordance with the drawing here shown. All dimensions on the drawing are important; cocks which do not conform to them in all respects will be rejected. The brass used in the cocks should conform as closely as possible to the following mixture: 68 per cent. of copper, 19 of zinc, 12 of lead and 1 of tin. No scrap material to be used in the mixture. A sample cock will be furnished on request. Handles of top burner cocks to be separated from the front of the main top by ample space to allow of the operation of the cocks without pinching or burning the fingers. All cock handles to rotate in a horizontal plane.

19. *Gas Rails.*—Gas rails to be not less than ¾ inch, and all ends to be carefully reamed on the inside to remove the obstruction or burr caused by cutting. Gas rails not to be constructed of bent pipe. Rail supports to be of split instead of solid pattern. The oven rail and the cock to be on the operator's right hand when facing the range. To be two supports for the oven rail. Oven rail supports to be so designed that, by removing caps from them, the rail may be swung outward, without removing the bolts that hold the main part of the support to the side of the range, and without straining the oven cocks. The riser from the oven rail to be located at the back of the range. The top of the riser to terminate with a ¾ inch by ⅜ inch by ¾ inch tee instead of an ell, the horizontal rear opening being fitted with a plug.

20. *Drip Pans.*—Drip pans under the top burners to be galvanized; to have the 4 edges turned up and the corners made tight; to be of ample length, breadth and depth to catch and contain anything spilled through the top grate; not to bind on the sides of the burner box, and to have handles.

21. *Oven Racks.*—To be 2 oven racks of light, strong and durable construction, preferably of the double reinforced type. Oven racks and broiling pans to lie perfectly flat, both before and after the oven is heated, and not to bind against the rack supports.

22. *Elevated Ovens.*—Air supply to elevated ovens to be taken in at back or sides, so as to avoid as far as possible the drawing in of products from the top burners.

23. *Cabinet Ranges.*—A tee to be placed in the oven gas rail between the back burner cock and the back of the range. This tee to have its opening down and to give the same location for the gas riser as with an ordinary single or double oven gas range. Provision to be made on these ranges for connection at either end. No piping to be located or run under the supporting frame of the range. The supporting frame to be made of 2-inch by 1-inch tee or 2-inch by 1½-inch by ¼ inch angle section steel, and to be built of even heavier material if necessary to keep the range from bending or sagging under any conditions.

EXHIBIT "C."—1910 WATER HEATER SPECIFICATIONS 1010.

1. *Capacity.*—Heaters submitted for test to be adjusted to burn fifty (50) cubic feet per hour, and have a maximum capacity of at least sixty (60) cubic feet per hour at 20-tenths inches of water pressure.

2. *Jacket.*—The jacket, or outside shell of heater to be of cast iron and to consist of four main parts, as follows:

One top casting.
One back jacket casting.
One front jacket casting or door.
One base casting.

Ornamentation to be of attractive but simple design.

The top casting and the base casting to be attached to the back jacket casting by through stove bolts with nuts, which are to be so located as to make all of the bolts heads and nuts easily accessible.

The back jacket casting to have two lugs cast on one edge, to engage the lugs on the front casting, or door and support same; and to have suitable door catch on the opposite edge.

The front jacket casting, or door, to extend the full length of the heater and not to be permanently attached to the other parts of jacket, but to have lugs and pins, and to be used as a door for lighting the burner, cleaning the inside of the heater, etc. The lugs on the door casting to set between the lugs on the back jacket casting, drive-pins to be used for holding same. The door lugs at top to be longer than the door lugs at bottom, so that door will swing open when unlatched. A suitable handle, with a positive catch, to be attached to the door casting by a through stove-bolt with nut. To insure the proper freedom in operating the handle, the door casting should be tapped to receive the bolt holding same, the nut on the bolt acting simply as a lock-nut. Provision to be made for observing the flame of the burner without opening the door; this provision perferably to consist of a small cluster of holes in the door casting, so arranged that there will be no possibility of mistaking them for lighting holes. The jacket preferably to be of as small an overall diameter as allowable for the proper combustion of the burner and arrangements of the water carrying parts.

3. *A Distinctive Name and Size Number.*—A distinctive name and size number should be plainly cast on the outside of the door casting.

4. *Flue Connection.*—The top casting to have an oval or circular collar for flue connection, cast on the top, and set to one side toward the back, so that the flue, when connected, will clear the water pipe. The opening in the collar, if oval, to be as shown on the drawing. If round to be of such a size that a 3-inch flue pipe can be used. This collar to be so ventilated that, when no flue connection is used, the placing of a vessel over the collar will not prevent the escape of the products of combustion.

5. *Insulation.*—No insulation, other than the cast iron jacket itself, is required. If air space, asbestos or other insulation is provided, it should be completely covered and inclosed by shells of cast iron, shaped to fit the inside of the front and back jacket castings. These

shells should be permanently attached to the jacket casting by through stove bolts with nuts.

6. *Water Carrying Part.*—If a coil type is used, the inlet or bottom end of the coil or coils, to be brazed to a cast brass fitting, which should extend through an opening in the back jacket casting, and the top, or outlet, to be brazed to a cast brass fitting, which should extend through an opening in the top casting. Those parts which extend through these openings to be hexagonal in shape to fit hexagonal openings in the jacket castings, and to be furnished with shoulders to bear against the inside faces of the jacket castings, thus preventing the fittings from being drawn through too far by the locknuts specified below. Each of these fittings to have a female iron pipe thread for water connection, and to have a male iron pipe thread on the same end for locknut, holding fitting permanently in place in the jacket casting.

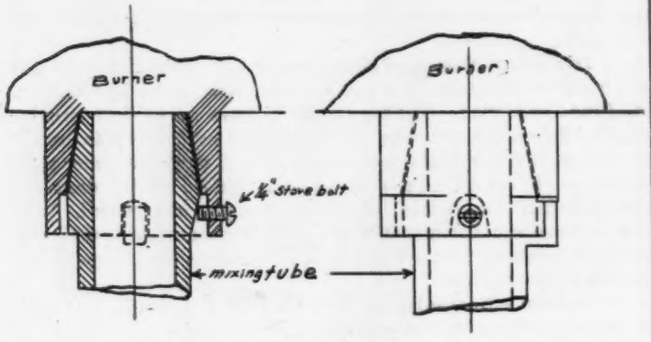
Copper pipe to be used in the coils, the pipe to be seamless, of the best quality, and of not less than No. 20 gauge (Stub's Standard). Coils to be smooth and free from kinks, and, when completed, with fittings brazed on, to be subjected to a minimum pressure test of 200 pounds per square inch. If the water carrying part consists of a series of separate castings, they should be cored brass, or iron, castings, with all inlets and outlets tapped with female iron pipe threads; joined together with double male nipples with a hexagonal center; inlet and outlet ends of the made-up water carrying part to be fitted with nipples of either iron pipe size, brass or galvanized wrought iron, of sufficient length to extend through the top and bottom of the jacket to allow of the water connections being easily made; nipples to be of brass or iron to correspond with castings. Complete internals, with both inlet and outlet nipples attached, to be subjected to a minimum pressure test of 200 pounds per square inch. If the water carrying part consists of one casting, it should be a one-piece cored brass, or iron casting tapped on each end with female iron pipe threads for water connection. The ends of the casting itself to project through the jacket of the heater, or to have iron pipe size brass, or galvanized wrought iron nipples attached to allow of the water connection being easily made. Complete water carrying part, with nipples (if used) to be subjected to a minimum pressure test of 200 pounds per square inch.

On cast internal type of heaters the jacket preferably to be supported by the internal itself, and to be held in place by two ¼-inch stove bolts at top, to serve as set screws. Heaters to be so constructed that the relative positions of the water carrying parts, jacket and burner are fixed in regard to each other, so that there is no possibility of their not being put together properly.

7. *Burner*—The burner to be preferably a 1-piece cored casting with a separate mixing tube. To have drilled ports and to be so designed as to give as wide a variation in consumption as possible with good combustion. To be securely fastened in its position, but not to be bolted in place, and to be easily removable for cleaning, preferably through the door of the heater.

The inlet end of the burner to be ground to fit the ground end of the mixer tube; to be tapped to receive a ¼-inch stove bolt to serve as a set screw to hold mixer tube; and to have a slot to engage a rib on the mixer tube to insure its proper location.

The air mixer and tube to be a 1-piece cored casting, separate from the burner. To have the outlet end ground to fit the ground opening in the burner; to have a pronounced lug or set for the stove bolt, to insure a permanent, positive joint between mixer and burner, and to have rib or web to engage a slot in burner to insure the proper location of the mixer tube. (See sketch.)

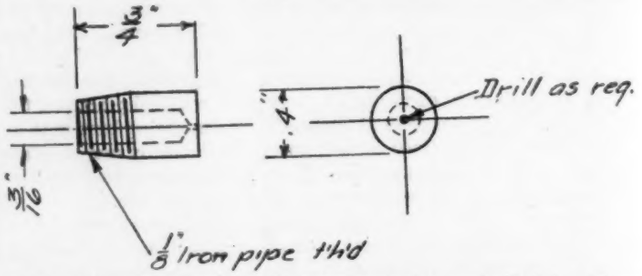


Method of connecting burner and mixing tube.
NOTE—Sketch shows method and not sizes.

Mixer to have a flat-face, machined off and fitted with a close-fitting, flat-face air shutter, to be held in place by a locknut on cock. The shutter itself to be of substantial cast or malleable iron, or of nickel plated, stamped sheet steel of not less than No. 20 gauge (U. S. Standard).

Gauze pillar burners, as described below, will, however, be accepted. A set of (say) six cast iron pillar burners with fixed air supply is preferable. These burners preferably to be of the double gauze type; to have drilled ports in raised lugs, and to slip into place through the door, being held in position by slipping over the spuds or gas nozzles.

The gas-way to the pillar burners to be a cast iron ring, firmly bolted to the jacket by means of lugs and stove bolts, and so supported that a sufficient quantity of air will be supplied to the burners. The condensation cup, as hereinafter described, to fasten below this ring. The cock to be as shown in drawing, with orifice spud omitted. The spuds used on the pillar burners to be as shown in sketch.



8. *Cock.*—The gas way to the burner to be controlled by ¼ turn cocks, which are to be made strictly in accordance with the drawing here shown. All dimensions on the drawing are important; cocks which do not conform to them in all respects will be rejected. The brass used in the cocks should conform as closely as possible to the following mixture: 68 per cent. copper, 10 per cent. zinc, 12 per cent. lead and 1 per cent. tin. No scrap material to be used in the mixture. A sample cock will be furnished on request.

9. *Condensation Cup*—A cast iron cup, of sufficient size to catch and retain all of the condensation which may form, to be located underneath the burner. Any openings for water or gas supply through to the heater to have a raised edge to prevent condensation overflowing at these points. Cup to be permanently located, at the proper distance below the burner, by lugs cast either on the cup or on the base casting and preferably to be supported by the mixing tube of the burner. If supported by the mixing tube, and same is not centered through the cup, but is eccentric, the cup to have a pronounced slot to engage a corresponding web on the mixing tube to insure centering the cup under the heater.

10. *Air Supply*—Air for the burner to be taken in at the bottom of the heater and the products of combustion to be properly baffled to give heater its highest efficiency and to reduce flue temperatures to the minimum, without smothering the burner flames.

11. *Bolts*—All bolts and nuts used to have standard stove bolt threads.

EXHIBIT "D."—WATER HEAT SPECIFICATIONS.

Burners firmly supported without bolts, easily removable, and with loose cap similar to style specified for range top burners. Casing to raise for lighting, or with hinged swing-door forming one-half of casing to open for lighting, having friction clasp. Constructed so that straight water inlet connections can be made to either side of lower section of coil. Heaters to have support from floor to base of heater. Valves, insulation and flue collar similar to specifications for ranges.

Iron coil, constructed to be easily drained, and with smooth openings through coils. Staggered section of coils to be arranged so that all possible heat will be applied uniformly to each section in turn, and with sufficient circulation in coil to prevent the lodging of sediment in any part of coil. Water openings to project through heater far enough to provide a suitable hold for a pipe wrench and should be tapped ¼-inch standard pipe thread.

Sizes: One for 30-gallon storage tank. One for 60-gallon storage tank. Opening for gas connection, not less than ½ inch. Flue opening to take 4-inch pipe drilled for pin to hold flue pipe.

The President—What is your pleasure in regard to the Report of the Committee on Utilization of Gas Appliances.

On motion of Mr. Norcross the report was accepted and approved.

The President—Next we have the report of the

WRINKLE DEPARTMENT,

by Mr. F. L. Cross, Editor, to whom our thanks are due.

Mr. Cross—I merely wish to say that the report has been printed. I thank you for the hearty support that has been given me.

The President—Next we have the

REPORT OF COMMITTEE ON CALORIMETRY.

Mr. Klumpp—Mr. President and Gentlemen: I want to report that the Committee on Calorimetry this year have continued their work, begun last year, investigating various calorimeters and methods of operation. The work was conducted at the University of Wisconsin, the same as last year, principally by Mr. Kowalke, a member of the Committee and a member of the Institute. We went over the work generally and found that the instructions given last year were practically correct; in other words, we have no reason to change the directions there given. We emphasize particularly the selection of apparatus, particularly meters. We call attention to the interior water overflow, which causes trouble and discrepancies. We know of a case where a large sum of money was held up on a contract, because an error of 15 to 20 per cent. was made on the calorific value of the gas, due to an error of registration of meter, from this cause.

We particularly recommend high grade thermometers. Get thermometers that are calibrated and standardized, and work them in pairs. Such thermometers can be obtained at $12 to $15 apiece; but you know what you are getting. A cheap thermometer might give a variation of 10 to 20 B.T.U.'s.

The principal difficulty, as to the accuracy of calorimeters in the past, has been the temperature of the inlet water. Last year we said that the temperature of the water should be the temperature of the room. We investigated that subject very thoroughly this year. With the room temperatures at 70°, and water temperatures as low as 40° and as high as 90°, we obtained a curve that showed the error for various temperatures. With water at 40° and the room at 70°, the error was as high as 20 B.T.U.'s plus; with the water at 90° and the room at 70°, 18 B.T.U.'s minus. This curve crosses the zero line at the temperature of the room and flattens out, so that it shows if the water temperature is within 5° of the temperature of the room, the reading should be within 1 B.T.U. of the heating value of the gas, provided everything else is right. This subject was further analyzed by determining the radiation of the calorimeter and the loss in absorption of sensible heat and the loss in absorption of latent heat. The radiation equalled from 5 to 6 B.T.U.'s., but the results came within 1 B.T.U. of the correct heating value when the water was within 5° of the temperature of the room. These readings are all shown in detail, the curves are shown in the plates on pages 104 and 104-A, and I think we have made it so plain that everybody will understand. We made an investigation of the effect of humidity on the calorimeter, and found that in extreme cases there was an error of 4 to 6 B.T.U's.; that is, when the humidity was zero to 30 per cent., the error was as high as 4 to 6 B.T.U's.; but if within 50 to 100 per cent., or normal conditions, the error was within 2 B.T.U's.

We heard of several calorimeters that were being offered on the the market, such as the Parr, the Lucke, and the Doherty, but were unable to obtain any of them. Last year our attention was brought to the Graefe calorimeter that was in general use. We obtained one from the agents in this country and made a thorough test of it. This calorimeter, you will remember, allowed the products of the combustion to leave at a temperature so high that it carried off the water formed as vapor. It, therefore, gives a low heating value, and this heating value depends upon the temperature of the products of combustion discharged. We tested it and found it 50 to 100 heat units out, and always low. We absolutely disapprove of such an instrument; it is cheap, costing only $25, but it gives readings that are in error from 10 to 20 per cent.

Last year the Committee recommended, you remember, that thermometers be placed on the same level. We have received a letter from the Junkers people in Germany stating that they are now building calorimeters in accordance with this design. They also now make a calorimeter that has provision for cleaning. We found that a very necessary qualification for a calorimeter. After it has been used for about 2 years it should be cleaned the same as a boiler, the scale or mud should be taken out of the water jacket. If the bottom of the calorimeter can be taken off, without unsoldering, it makes a much more convenient and reliable instrument.

I want to say that the committee still believe that we can get thermometers to read accurately with $\frac{1}{10}$ of 1°, that we can calibrate our meters to read correctly, and we can weigh our water or measure it accurately, and get a heating value that will be within about 1 per cent. of the actual heating value of the gas.

We recommend the use of a calorimeter cabinet. This should be built as shown in the report. The calorimeter should always be permanently installed in place with an overhead tank which will allow the water to attain the temperature of the room. In such a cabinet the calorimeter can be located so that it is always ready to use and not interfered with, observations can be readily made inside of 30 minutes, and a satisfactory manipulation of the instrument assured.

REPORT OF COMMITTEE ON CALORIMETRY.—*Synopsis.*

Introduction.—In 1907 the first Committee on Gas Calorimetry was appointed by the President of the Institute, and, after a year's investigation and experimental work, the report of this Committee was presented to the Institute, October, 1908.

This Committee, after a complete search of all available literature on the subject, found but little authentic information published that would enable it to draw any conclusions as to the best methods or the best instruments to adopt for commercial practice. It was, therefore, decided to obtain calorimeters of various types, and proceed with as thorough an investigation of the gas calorimeter as was possible in the limited time at its command. The report of 1908 gave a detailed description of the experiments undertaken and the methods adopted in arriving at the conclusions given. The experimental work, with such instruments as were obtainable, enabled instructions and precautions being formulated, which were considered necessary in assisting the average operator to a more accurate determination of the calorific value of the gas. The work undertaken at that time brought to light several important points that needed further investigation, to confirm these deductions and conclusions, and to this end the Calorimetry Committee was continued, and further experimental work was undertaken during the past year.

The result of these experiments, and the inferences deduced, are appended herewith, and seem to confirm the statements made by your Committee in 1908.

Synopsis.—Report, 1908.—To assist the reader of this report, it is deemed advisable to submit a brief synopsis of the work that was done last year, although no attempt will be made to go into details of the work, and for this purpose a copy of the 1908 report should be obtained and carefully studied.

The report presented to the Institute last year covered a short description of the practice of gas calorimetry in both America and Europe, and gave reasons for the increasing use of the calorimeter as an instrument for determining the quality of a commercial gas. It went into the principles of gas calorimetry, and describing the methods of general operation and the reason for selecting the units of measurement. An investigation of several types of calorimeters was made, and that type, embodying the principle of heating a certain quantity of water to a known temperature, was generally approved and adopted as being the most praetical method of determining the heating value of a commercial gas.

Four different makes of gas calorimeters were tested: The Junkers, Boys, Simmance-Abady and Sargent. Descriptions and cuts of these instruments were given, showing the methods adopted by the inventors in utilizing the principle of water heating. The instruments were purchased direct from the manufacturers by operating concerns, whose purpose was to use them in daily operation, and they were not specially prepared for scientific investigation. The Committee, appreciating the result of the publication of such an investigation, was exceedingly careful in the selection of a suitable location for its work, the adoption of most carefully calibrated meters and thermometers, which were checked by the best authorities, and also in selecting those operators whose work could be thoroughly relied upon and be unbiased.

Tests were made to determine the best type of meter for measuring the volume of the gas, a suitable type of governor for governing the pressure of the gas, and the most practical method of determining the exact quantity of water passed through the calorimeter. A careful study of the calorimeter proper was made to determine the most convenient and most accurate method of transmitting the heat from the gas to the water, the best type of gas burner to use, and what was necessary in the way of thermometers that would give accurate temperature readings. This question of thermometers occupied a large proportion of the time of the investigation, and it was only after many calibration tests that some few thermometers were found, which, with proper correction curves, were accurate enough to be adopted.

The work of the Committee was then devoted to the very important

subject of the water supply. This was found to be one of the fundamental qualifications for accurate work and the quantity of water to be used, and the inlet temperature and rise in temperature of that water were made the subject of very careful study. Further tests on the general efficiency of the calorimeter were made and gave results that confirmed previous investigations in Germany, by Dr. Immenkotter' and confirmed the views of the Committee that the gas calorimeter could be made and operated as an instrument of precision.

The operating instructions given in the report of 1908 were compiled after a thorough study of the subject. They were intended to be concise and explicit, and it was hoped would enable the average works' operator to operate a calorimeter with consistent results.

Finally, in the report suggestions were made for further investigation. These suggestions covered the work that the previous Committee was unable to carry through, owing to the limited time at its disposal, and it was desired that these determinations should be made if possible by continuing the investigation. The suggestions consisted of determining the effect on heating value resulting from a difference in temperature between the inlet water and the room temperature, the effect on calorific readings resulting from a varying atmospheric hnmidity and a determination of heat lost through the products of combustion leaving the calorimeters above or below the atmospheric temperature.

This work was continued along these lines, and these results, with those of some further experimental work carried on, are herewith submitted in this report:

This Year's Investigation.

This year, as in last, your Committee has confined itself to the investigation of the water heating type of calorimeter, and continued its investigation with some of the instruments previously tested, with the addition of some others obtained for comparative purposes. The investigation has followed somewhat the lines laid out, and suggested in last year's report as being desirable to continue, and results obtained signified the correctness of the deductions then made.

Appreciating that one of the greatest and most frequent causes for discrepancies in results was the variation in temperature of the inlet water from that of the measured gas and surrounding air, a series of experiments were undertaken to determine what this discrepancy was, and then an analytical determination of the individual causes and confirmation of the results. This investigation is shown in full in the following pages.

The results of this test go to prove the conclusions and instructions, given in 1908, that the temperature of the inlet water should be approximately the same as the gas and room atmosphere. A series of experiments were made to determine the effect of varying the temperature of water at the outlet. This work was, of course, limited by the capacity of the calorimeter for water, and the rate at which the water could be made to pass through the instrument. The limits of this were comparatively close, and results confirmed last year's investigation. (See plate XIII.)

From the observations made in these tests it was apparent that there was some discrepancy in readings, due to the difference in humidity between gas and air supplied and the products of combustion. So preparations were made to vary artificially the humidity of the gas and air delivered to the calorimeter. The result of this test is appended and shows that the error caused by the humidity of the air is a relatively small quantity, seldom exceeding a figure that will cause excessive discrepancies in final results. This observation is directly opposed to results observed in determining the value of a gas by readings of illuminating value which show greatly the effect caused by variations in humidity.

Several calorimeters were obtained by the Committee for the purpose of comparison. These consisted of one other Junker, two instruments of a further improved Sargent type, and a Graefe calorimeter, the last a cheaper article now being placed upon the American market. The details of these last comparisons are included in the reports as tending to conclude the work of the preceding year. An investigation was further made to determine what could be obtained in a serviceable thermometer, that would be accurate at all points in the scale and show positively the difference in the inlet and outlet water temperatures; the results of this work are given by a description of these thermometers and a set of calibration curves obtained from a test of a pair received by the Committee. The investigations of this year were made at the laboratories of the University of Wisconsin and were a continuation of the experiments reported upon by the Calorimetry Committee of 1908.

The conditions of gas supply and storage were identical as before, and consisted of taking all samples direct from the city mains supplying the laboratories. These samples were stored in gasholders of 60 cubic feet capacity each. From these holders the gas was supplied to service line connected to each calorimeter and uniform pressure maintained through a Connelly governor.

Calibration of Instruments.—Because the accuracy of the determination of the heating value of a gas depends so largely on the accuracy of the measuring devices, all water weighing buckets, meters and thermometers were accurately calibrated before using them to make tests on the various instruments. This was done in every case as was described in last year's report.

In all the tests of this investigation the quantity of water used for test was determined by weighing in copper buckets. Sufficient numbers of these buckets to supply each calorimeter were available, and they were all made the same weight, so that a common counter-balance could be used. The water weighed on a torsion balance sensitive to .001 of a pound in 10 pounds. Each bucket, with the inside wet, was carefully balanced against the counterweight. This was done to facilitate weighing. Before balancing the wet bucket it was shaken in an inverted position for about 5 seconds to remove the drip.

The meters used in the tests were all calibrated against a ½ cubic foot bottle which had been previously calibrated by weighing the volume of distilled water at 62° F. contained in the bottle. With this device all meters were regulated to an accuracy of .05 per cent.; each test on the meter consisted in passing .5 cubic foot of gas through at the rate to be used subsequently, which necessitated two fillings of the bottle. The meters were tested under the same pressure and approximately the rate of flow at which they were to be used in the subsequent tests. They were again tested after the investigation was concluded. All the thermometers used in the tests were carefully compared against thermometers of the University of Wisconsin which had been calibrated by the Bureau of Standards, Washington, and the German Bureau of Standards, and correction curves were constructed and used with each thermometer.

Thermometers.

During the past year much time has been given to the study of thermometers for use with the calorimenter. The calorimeters in past as supplied to the commercial trade were equipped with thermometers, graduated to tenths of a degree, either Centigrade or Fahrenheit, and these thermometers were generally accepted as being correct at all temperatures and no correction factors were used. The careful comparison of many of these with calibrated standards has shown many thermometers to be irregular and inaccurate. When supplied in pairs to measure the inlet and outlet temperatures the error was found to be variable in various parts of the scale, and if the thermometers were interchanged inconsistent results were obtained. Under these conditions the investigation was conducted entirely with thermometers calibrated through the entire range of temperature, and correction curves constructed for each one. While it was thought at first this calibration was only necessary for such a close and careful investigation as was being made, the great number of inaccurate thermometers received with such commercial instruments as were obtained, and the resultant error caused by such in-

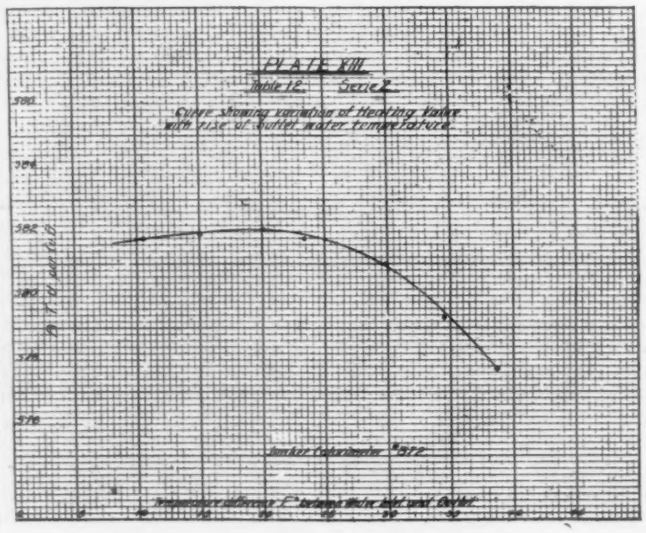


PLATE XIII.
Table 12. Series 2.
Curve showing variation of Heating Value with rise of outlet water temperature.
Junker Calorimeter

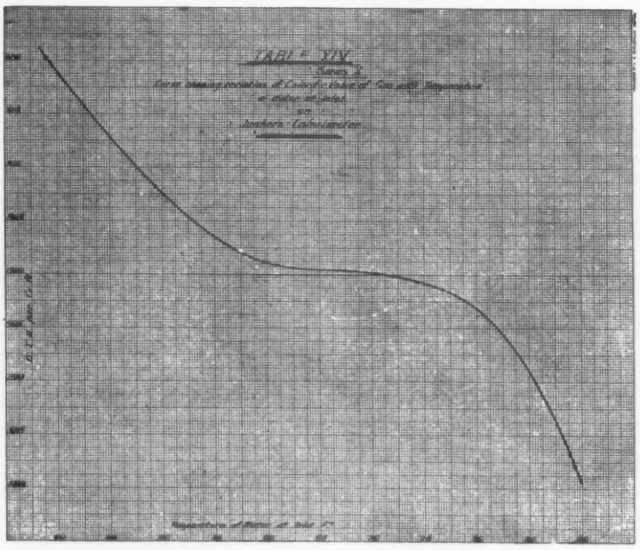


TABLE XIV.
Junker Calorimeter.

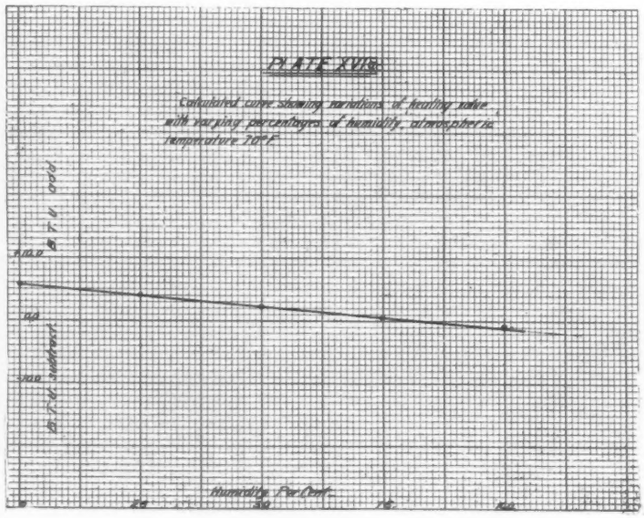


PLATE XVIII.
Calculated curve showing variations of heating value with varying percentages of humidity, atmospheric temperature 70° F.
Humidity Per Cent.

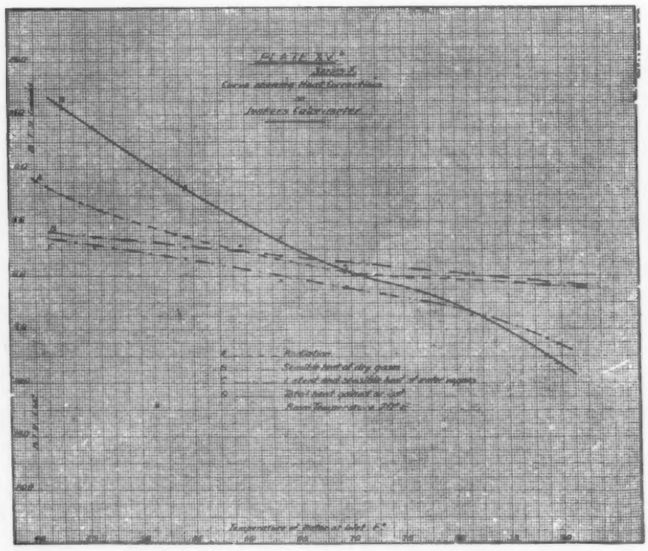


PLATE XV.
Junker Calorimeter.

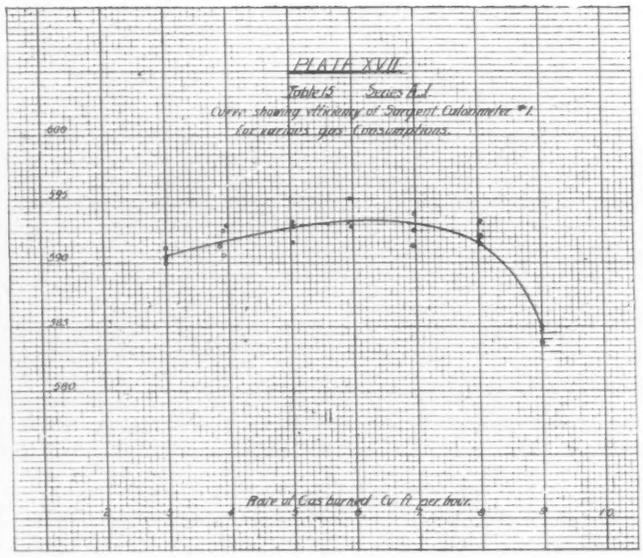


PLATE XVII.
Table 15 Series A.A
Curve showing efficiency of Sargent Calorimeter #1 for various gas consumptions.
Rate of Gas burned Cu. ft. per hour.

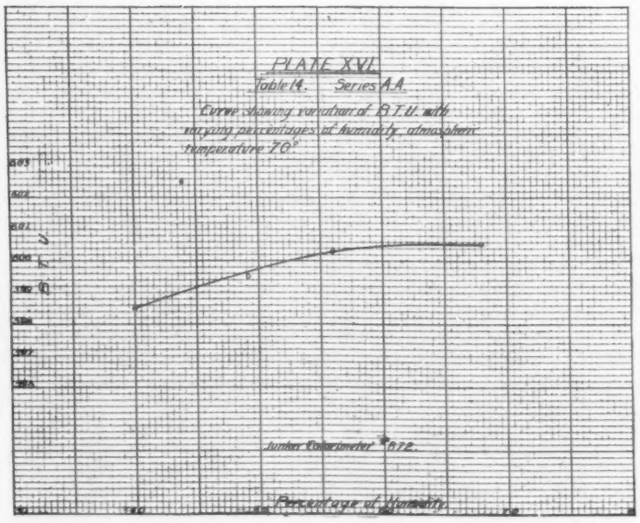


PLATE XVI.
Table 14. Series A.A
Curve showing variation of B.T.U. with varying percentages of humidity atmospheric temperature 70°
Junker Calorimeter #672.
Percentage of Humidity.

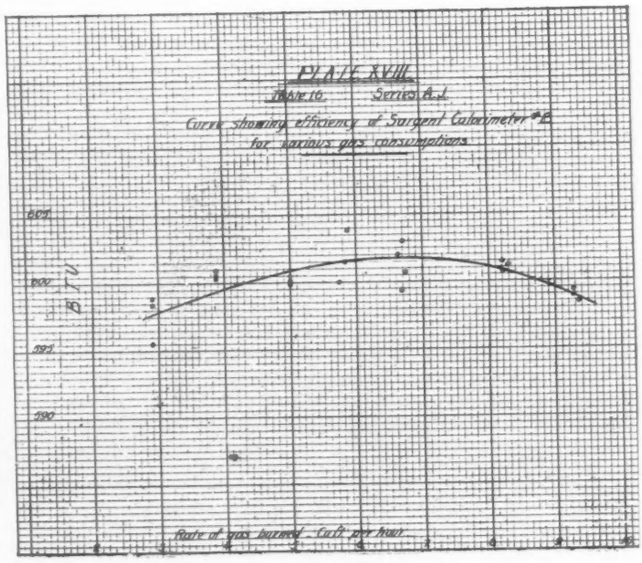


PLATE XVIII.
Table 16. Series A.A
Curve showing efficiency of Sargent Calorimeter #2 for various gas consumptions.
Rate of gas burned Cu. ft. per hour.

accuracies, led us to believe that only the best thermometers, and these carefully calibrated, are serviceable for important commercial use.

The methods of calibration were carefully described in last year's report, and the same methods were adopted in the further investigation; careful comparisons were made with the Thermometer No. 4,170, of Chemical Engineers Department, received and standardized by the Bureau of Standards, Washington, June 14, 1909.

Your Committee has taken up this subject and, through arrangements made with Messrs. Hohman & Maurer Co., of Rochester, N. Y., they are now supplying a thermometer that has been built according to its recommendations. The thermometers have a range from 65° to 115° F., and graduated to $\frac{1}{10}$°, having an auxiliary division at 32° F., which is convenient for carefully checking the ice point. These thermometers are carefully made and have a bore that is exceedingly accurate.

As an evidence of the exactness to which these thermometers may be paired, a set of calibration curves are attached of a test made on two of them, H. M. numbers 122455 and 122456. The curves coincide closely with the certificate furnished by the makers. The test of Aug. 9, 1909, showed a change in the ice point of both thermometers of $\frac{1}{10}$° higher than shown in the test of December, 1908. It was, however, noteworthy that the readings of the two thermometers were the same, that they varied together, and that the relative readings of the two were unchanged, the variation taking place throughout the entire scale. This change was due to a further ageing of the thermometers, for if they had been completely aged there would have been no perceptible change in the ice point. This fact of thermometers ageing signifies that the inlet and outlet thermometers of a calorimeter should be secured in pairs and used together. If, after a year's use, one should be replaced with a recently made thermometer, a change will take place in their comparative readings as the newer one ages. The error of $\frac{1}{10}$° above mentioned may seem a small matter, and it is in most measures of temperature, but when the calorific value of a gas of about 600 B.T.U. is determined with a rise of 15° F., a difference of $\frac{1}{10}$° means an error of $\frac{1}{15}$° of the total heat of the gas, or 4 B.T.U., so proportionally to other errors. So when thermometers can be obtained to read accurately within this limit, we recommend them for all commercial purposes. The errors of determination in reading the calorific value of the gas are not affected in anything like the extent by the other temperatures taken in observation, such as the temperature of the air, metered gas and products of combustion; but the thermometers used at these points should read to degrees and be accurate within a fraction of 1°, and should be calibrated, as cases have been found where the thermometers were several degrees out.

Arrangement of Apparatus for Tests.

It was evident, after the calibrations of the various instruments had been made, that certain devices were unsuitable for fair tests of the calorimeter, and the calorimeter outfits were, therefore, arranged so that each would operate under the most efficient conditions.

Water Supply.

The water for the test was taken from Lake Mendota and was clear and free from suspended matter. A tank of about 60 cubic feet capacity, located about 40 feet above the calorimeter, had a separate supply cock. During the summer this water had acquired the temperature of the atmosphere, while in the winter the water was heated to room temperature before passing into the calorimeter. A very satisfactory heating device consisted of a 5-gallon jar, fitted with electrodes and filled with a solution of sodium sulphate, through which alternating currents passed. The solution was agitated continuously with a motor-driven stirrer. A copper tube, about ¼ inch internal diameter, was wound in a spiral and connected in series with the calorimeter water supply tubing from the main cock on the water pipe. The water supply to the calorimeter, in passing through the copper coil immersed in the electrolyte, could be heated to any desired temperature and kept at any desired temperature within 0.1° F., by proper regulation of the electric current through the electrolyte. For each series of tests on the calorimeters the gas tanks were filled with a fresh supply of gas from the city mains and allowed to stand for some time. All tests were run in series, which were lettered or numbered, and a new series was started with a fresh supply of gas in the tanks. Comparative tests in different calorimeters were made as nearly simultaneous as possible.

During each series of tests the humidity of the atmosphere was determined by wet and dry-bulb thermometers, upon which a current of air was directed. The data from each test was recorded on blanks printed for the investigation, which greatly facilitated the tabulation and computation.

The Junkers' calorimeter, No. 872, of the University of Wisconsin, which had been used in the general efficiency tests and whose accuracy had been previously determined by means of an electrical heater, as described in the 1908 report, was used for the comparative readings during this summer's investigation. This instrument had been shown to give results above 99.5 efficiency, and was considered sufficiently accurate for the purpose. This same calorimeter was used in comparative tests with the Junker's calorimeters, Nos. 571 and 1137, which gave almost exactly identical results. It was, therefore, decided to use Junkers No. 872 in making examinations of some of the finer points of the investigation.

Investigation of Variation in Heating Value Caused by a Difference in Temperature Between the Room and Inlet Water.

In many places where a calorimeter is installed, the water supply is taken directly from the city service mains. In the winter the water is much colder than the room, and this is especially true in a cold climate. In other cases the water supply may be much warmer than the room. The purpose of this series was to determine the error that arises when the water supply is not the same as the temperature of the room.

The Junkers calorimeter, No. 872, was again used and the apparatus arranged in all respects like the other tests, except that the supply water passed through a copper coil immersed in an electrolyte. This arrangement permitted the cooling of the water nearly to its freezing point, also heating it to any desired temperature, and holding the water at this temperature for any length of time.

The room temperature was practically constant, for it varied only from 68° F. to 70° F., and the temperature of the water was varied from 40° F. to 90° F. The rise in temperature of the water at the outlet of the calorimeter over the inlet in all tests was approximately 15° F., and the rate of combustion about 7 cubic feet per hour, which had heretofore been determined as a satisfactory point of operation.

The results of these tests are shown in Table 13 and Plate XIV. (Series X). The heating value gradually decreases as the temperature of the water at the inlet approaches and surpasses the temperature of the room. Below room temperature the curve bends down and above room temperature the curve bends up. The change in heating value is much slower below than above room temperature. There is a point of inflection in the curve and at that point would be the temperature at which the calorimeter should be operated to get correct resuits, as is shown in Plate XIV.

Thermal Balance of Tests in Series "X."

The exact point of inflection of this curve is not at once apparent, it becomes necessary to analyze the sources of loss and gain at the various temperatures. If the proper corrections were made at each temperature, the resulting curve should be a straight line, since the sample of gas was homogeneous and the calorimeter constant in its operation. The sources of error to be investigated are: (1), Radiation or absorption of heat by by the calorimeter body; (2), the sensible heat in the air and gas supplied and in products of combustion; (3), the latent heat in the vapor carried by the products of combustion.

1. Heat Absorbed or Radiated by the Calorimeter.

That heat is absorbed from or radiated to the atmosphere by the calorimeter is due to the fact that the water supply entered the instrument at temperatures ranging from 30° F. less than room temperature to 20° F. more than room temperature. These various amounts of heat are determined by allowing the water to flow through the calorimeter without having any flame inside, but having the combustion chamber and vent for the products of combustion set exactly as in the other tests. The temperatures at the inlet and outlet were then taken, and it was observed that when water colder than the air flowed through, the outlet temperature was greater than the inlet temperature, and when the water at the inlet was warmer than the room the outlet thermometer showed a lower temperature. The average amount of water passed while 0.2 cubic feet of gas could be burned at the rate of 7 cubic feet an hour was 7.339 lbs., then, per cubic foot of gas, the total water would be 36.695 lbs. The heat absorbed or radiated per cubic foot of gas burned is, therefore, the product of 36.695 and the change in temperature. The data and computations are tabulated below;

Room Temp.	Temp. of Inlet Water Degs. F.	Pounds of Water Passed per Cubic Feet.	Change in Temp. of Water Degs. F.	B. T. U. per Cubic Feet.	How Disposed.
.....	40.0	36.695	+ 0.2430	8.92	Absorbed
.....	53.3	36.695	+ 0.1044	3.835	"
.....	59.4	36.695	+ 0.0792	2.905	"
.....	70.1	36.695	— 0.0036	0.132	Radiated
.....	79.2	36.695	— 0.0018	0.066	"
.....	88.7	36.695	— 0.0216	0.793	"

At 40° F. there are 8.92 B.T.U. absorbed, at 70° F., practically no heat is absorbed or radiated, while at 90° F. there is only about .8 B.T.U. radiated. This curve gives one reason why the water supply should be at the temperature of the room, for then there is a thermal balance.

2. The Heat Balance of Incoming and Outgoing Gases.

The heat balance between the dry incoming and outgoing gas can only be obtained from an analysis of the combustible gas and the products of combustion, from which data the air supplied for combustion and the volume of the products of combustion can be computed. The combnstible gas and the air supply bring in a given amount of sensible heat constantly, since the gas and air temperature did not vary appreciably during the test. At different stages in this series of tests the products of combustion leave at temperatures different from the respective gas and air temperatures, and, therefore, heat is either absorbed or radiated, depending on whether the products leave at a lower or higher temperature, respectively, than the incoming gases. The design of the calorimeter is such that the products of combustion are cooled to the temperature of the base of the calorimeter, which is practically the temperature of the inlet water. Since the combustible gas is composed of some hydrocarbon gases whose combustion forms water vapor, therefore, a cubic foot of dry, combustible gas, burned with the required amount of dry air, will in general form a smaller volume than the combined volume of incoming gases. If then the incoming gases and the products of combustion, both dry, were at the *same* temperature, the total sensible heat in the incoming gases is still higher than the heat in the products. It is upon these facts that the following computations were based.

(*a*) The Gas Analysis.

The analysis as reported is on the basis of saturated gas at 29 inches of mercury and 68° F. The volume of dry gas in a unit volume of the sample taken is expressed by the equation $V = V_1 \frac{h - a}{h}$ where V = vol. dry, V_1 = vol. wet, (h) = barometer in inches of mercury, and (a) = vapor tension at 68° F. inches of mercury. One cubic foot of saturated gas is equivalent, then to $1 \times \frac{29.00 - 0.68}{29.00}$ = 0.976 cubic feet. If the percentage composition of each constituent in the satuated gas be divided by 0.976, the percentage of that constituent in a dry gas is obtained.

The combustible gas had the following analysis:

Components.	Per Cent. Wet.	Per Cent. Dry.
CO_2	3.90	4.00
Illum	10.70	11.00
O_2	0.10	0.10
CO	32.30	33.10
CH_4	17.20	17.61
H_2	29.6	30.30
N_2	3.8	3.89
H_2O	2.4	....
Total	100.00	100.00

The product of combustion had the following analysis:

Components.	Per Cent. Wet.	Per Cent. Dry.
CO_2	14.0	14.35
O_2	2.0	2.05
N_2	81.6	83.60
H_2O	2.4	....
	100.00	100.00

(*b*) The Air Supplied and the Volume of Products of Combustion.

Since the gas was burned completely, and since the composition is known, the air required for its combustion is easily computed. It is assumed here, for want of more definite information, that the "illuminants" are ethylene C_2H_2. The average humidity of the air supply is 62 per cent.

Gas.	Cubic Feet Volume.	Oxygen Needed.	Products. CO_2.	Products. H_2O.	Products. N_2.
CO_2	.04	....	.04	....	....
C_2H_4	.11	.33	.22	.22	....
O_2	.001	.001	....	....	....
CO	.331	.1655	.331	....	....
CH_4	.1761	.3522	.1761	.352	....
H_2	.303	.1515	....	.303	....
N	.0389	....	....	....	.0389
Total	1.0000	.9982	.7671	.875	.0389

Assuming the gas analyses and analyses of the products of combustion as correct, we figure that on the combustion of one cubic foot of dry gas there is formed .7671 cubic foot of CO_2, and from the analysis of the dry products of combustion we find that each cubic foot of the products formed .1435 cubic foot of CO_2; therefore, there must have been formed of dry gas .7671 + .1435 = 5.347 cubic feet of products. In the table above there was required for the combustion of 1 cubic foot of dry gas .9982 cubic foot of oxygen. This would be equivalent to 4.799 cubic feet of dry air, containing 3.801 cubic feet nitrogen.

In the combustion of 1 cubic foot of dry gas there are formed .7671 cubic foot of CO_2, .0389 cubic foot of nitrogen, and the nitrogen resulting from the necessary air which we have calculated as above, equal to 3.801 cubic feet, giving a total of the theoretical products of combustion of 4.607 cubic feet.

The actual products of combustion calculated as 5.347 cubic feet; therefore, the difference of .7400 cubic foot must be the volume of the excess air. Calculating this as a percentage on the volume of air theoretically, assuming oxygen in air as being 20.8 per cent., we have 4.799, and we find that 15.42 per cent. excess air was used, which is equivalent to 5.53 cubic feet of dry air per cubic foot of dry gas, both being at the same temperature and pressure. The results of this deduction have been used in subsequent calculations.

(*c*) The Sensible Heat in the Dry Gas.

In determining the sensible heat in the dry gas the gas analysis is again referred to, and the thermal capacity of the gas is calculated from the weights of the constituent gases and their specific heats per pound. In the same way the thermal capacity of the products of combustion is obtained. See following table.

Gas.	Volume in Cu. Ft.	Weight per Cu. Ft. in Pounds.	Total Weight in Pounds.	Specific Heat per Pound.	Thermal Capacity B.T.U.
CO_2	.04	.11637	.004658	.216	.00100
C_2H_4	.11	.0741	.00815	.404	.00329
O_2	.001	.08463	.00085	.217	.00023
CO	.331	.07407	.02450	.245	.00600
CH_4	.1761	.04234	.00746	.593	.00442
H_2	.303	.00530	.00160	3.409	.00546
N_2	.0389	.07429	.00289	.244	.00073
					.02113
Air	5.53	.0766	.4235	.2376	.1006
Gas and air at 60° F.					.12173
Gas and air at 70° F.					.1194
Products of Combustion.					
CO_2	.1435	.11637	.0167	.216	.00361
O_2	.0205	.08463	.0017	.217	.00037
N_2	.8360	.07429	.0620	.243	.0151
One cubic foot at 60° F.					.01980
One cubic foot at 70° F.					.01872
5.347 cu. ft. = .01872 × 5.347 = .1002 thermal capacity B.T.U.					

From this thermal capacity it is very easy to calculate the sensible heat admitted and discharged by simply observing the room temperature and the exhaust product temperature in the tests 1–24. These are shown in the following table, giving actual B.T.U. absorbed and discharged by the calorimeter, due to the sensible heat in the air, gas and products of combustion.

This table was constructed by taking the room temperature, the thermal capacity of the gas and air, as indicating the sensible heat admitted to the calorimeter above 0° F., and taking the exhaust temperature and thermal capacity of the products of combustion, giving total sensible heat discharged above 0° F. The difference in these two readings indicates the sensible heat absorbed or given up by the calorimeter, and is represented by Curve B, in Plate XV.

It is apparent that the difference in specific heat of the incoming and outgoing gases, and the change in volume, have only a slight influence on the heating value. Since the products of combustion of a gas containing hydrogen are always going to be less in volume than

incoming gases, a small gain is always found when the inlet water is approximately at the same temperature as the room. In commercial work this error is negligible.

Tests.	Room Temperature.	Exhaust Temperature. Products of Combustion.	Sensible Heat. Amount Gas Admitted.	Sensible Heat. Products of Combustion Discharged.	Actual.
1-4	69.0	45.6	8.245	4.572	+3.673
5-8	68.5	54.2	8.180	5.435	+2.745
9-12 ...	68.5	63.2	8.180	6.340	+1.840
13-16....	69.5	72.4	8.305	7.263	+1.042
17-20....	70.8	81.5	8.460	8.170	+0.290
21-24 ...	70.4	88.6	8.410	8.885	—0.475

3. The Gain or Loss of Latent Heat of the Vapors in the Gases.

The combustible gas as it enters the calorimeter is usually saturated with water vapor, and in these tests precaution was taken to saturate it. The air supply may be saturated to various degrees of saturation, depending on the weather conditions. Tests of the products of combustion leaving the calorimeter in all cases was only a few degrees higher than the inlet water. Tests of Dr. Immenkotter and Prof. Junkers also showed that the products are saturated at the temperature of the inlet water. Now if the products of combustion are cooled far below room temperature the vapor content at the low temperature may be much less than the vapor content of the gases entering the calorimeter. Should the products leave at a temperature higher than the room temperature, and be saturated, a greater amount of vapor is carried away than is brought in, and thus the latent heat of condensation is lost from the calorimeter.

The combustible gas enters the calorimeter at 70° F., and saturated 1 cubic foot dry gas is equivalent to 1.024 cubic feet gas saturated at 70° F., and hence the vapor brought in per cubic feet of dry gas at 70° F. = 0.024 cubic feet.

Tests 1-24 are taken with the data supplied on Table 13, Series X., made on the Junkers calorimeter No. 872. The temperature is taken directly as given, as the temperature of the gas. The volume of dry gases per cubic foot for these various barometric pressures and temperatures are calculated and show practically a uniform volume of .976 for each set of temperatures. The aqueous vapor therefore carried in per cubic foot is .024 cubic foot.

Calculating from the analysis of the sample of gas given in the report the dry air required for combustion in each case is 5.406 cubic feet. This air was admitted in each case at different temperatures and different percentages of humidity. The required dry air in these conditions varies from 5.405 in tests 1-4 to 5.408 in tests 21-24, and required saturated air for these temperatures was 5.490 in tests 1-4 up to 5.552 cubic feet in tests 21-24. The volume of aqueous vapor included then in the air would be .085 in the first test to .144 in the last test. This volume of aqueous vapor in the air + the volume of aqueous vapor in the gas, which was in all cases .024, made a total volume of aqueous vapor of .109 to .168 cubic foot, or expressed in pounds, from .00481 to .00748 pound.

The above figures determine the weight of aqueous vapor carried in by the gas and air under actual conditions, as shown by the various temperatures and pressures for each set of tests.

To determine the weight of aqueous vapor discharged in the products of combustion, we first calculate the volume of dry products from the analysis of the gas submitted. This gives a volume in all tests of 5.2187. The exhaust temperatures in each instance are taken as the actual temperatures and run from 45.6 to 88.6° F. Therefore, the volume of the dry products must be expressed at these temperatures and run from 4.98 to 5.422 cubic feet. The calculated volume of these products saturated at the same temperature above run from 5.035 to 5.706 cubic feet. The volume of aqueous vapor in the products of this temperature would then run from .055 in tests 1-4 up to 2.84 in tests 21-24.

Comparing the quantity of the products with the aqueous vapor in the air and gas admitted, it is necessary to reduce everything to a standard volume and pressure. Therefore, this aqueous vapor corrected to 60° and 30 inches would be .0543 up to .2570, and the weight of this aqueous vapor would be .00258 in tests 1-4 up to .01223 pound in tests 21-24. From the tables we have the total weight of aqueous vapor taken in, and the total weight of aqueous vapor discharged, hence it is necessary to determine the total heat carried in by the vapor and the total heat carried out by the vapor.

Calculating this total heat as the heat both sensible and latent above 32° F., we have total heat introduced to the calorimeter running as follows: Tests 1-4 give 5.3054 B.T.U., while tests 21-24 give 8.2504 B.T.U. In the same way the total heat carried out in aqueous vapor run in tests 1-4 = 2.8277 B.T.U. up to 13.5631 B.T.U. in tests 21-24. This gives the total heat absorbed or lost by the calorimeter from the air and gas going in and the products going out under the actual conditions of temperature and pressure, and must be corrected for standard temperatures and pressures 60° and 30 inches for a cubic foot of dry gas .976 to agree with the previous investigation, which gave the following result:

Effect of Latent Heat of Aqueous Vapor.

Tests No.	1-4.	5-8.	9-12.	13-16.	17-20.	21-24.
Barometer	28.79	28.77	28.73	28.70	28.66	28.63
Temperature of gas	69.4	68.35	67.8	67.7	68.1	68.15
Volume of dry gas	0.976	0.976	0.976	0.976	0.976	0.976
Volume of aqueous vapor	0.024	0.024	0.024	0.024	0.024	0.024
Required dry air	5.406	5.406	5.406	5.406	5.406	5.406
Temperature and humidity of air	69° at 62 pr. ct.	68.5° at 62 pr. ct.	68.5° at 62 pr. ct.	69.5° at 75 pr. ct.	70.8° at 88 pr. ct.	70.4° at 100 pr. ct.
Required dry air at air temperature	5.405	5.405	5.405	5.407	5.408	5.408
Required saturated air at air temperature	5.49	5.49	5.49	5.15	5.33	5.52
Volume aqueous vapor air temperature	0.085	0.085	0.085	0.108	0.125	0.144
Total volume aqueous vapor at air temperature	0.109	0.109	0.109	0.132	0.149	0.168
Weight aqueous vapor taken in pounds	0.00481	0.00481	0.00481	0.00591	0.00664	0.00748
Calculated volume dry products, gas temperature	5.2187	5.1187	5.2187	5.2187	5.2187	5.2187
Exhaust temperature	45.6	54.2	63.2	72.4	81.5	88.6
Calculated volume dry products at exhaust temperature	4.980	5.073	5.173	5.263	5.354	5.422
Calculated volume saturated products at exhaust temperature	5.025	5.147	5.286	5.514	5.561	5.706
Calculated volume aqueous vapor at exhaust temperature	0.055	0.074	0.113	0.151	0.207	0.284
Volume aqueous vapor 60° — 30″	0.0543	0 07185	0.1076	0 1412	0.1898	0.257
Weight aqueous products	.00258	0.00342	0 00512	0.00672	0.00936	0.01223
Total heat above 32° aqueous vapor:						
Taken in	5.3054	5.3054	5.3054	6.5187	7.3279	8.2504
Given out	+2.8277	3.7475	5.6371	7.4189	10.3615	13.5631
Gain or loss at air temperature	+2.4777	+1.5579	—.3317	—.9002	—3.0336	—5.3127
Gain or loss at 60° — 30″	+2.675	+1.682	—.352	—.956	—3.225	—5.655
Corrected for 1 cubic foot dry gas	+2.74	+1.74	—.36	—.98	—3.31	—5.79

Tests.	B.T.U.
1-4	+ 2.74
5-8	+ 1.74
9-12	— 0.36
13-16	— 0.98
17-20	— 3.31
21-24	— 5.79

The results of these computations are plotted as curve "*C*" in Plate XV. It is apparent that at the higher temperatures at which the products leave the calorimeter the loss in heat energy due to the latent heat of condensation increases very rapidly and the actual amount is large. It is necessary, therefore, to regulate the damper at the exit for the products of the combustion that they leave at a temperature approximately the inlet water.

Now if the curves *A*, *B* and *C*, of Plate XV. be combined into one curve the total losses and gains will be given, and such a curve is shown at "*D*" in Plate XV. The curve "*D*" when applied to the results shown in curve *A*, in Plate XIV., at the corresponding tem-

perature should give a straight line. There is a slight deviation from this condition due to experimental errors, but if the average of all these points is taken it gives a heating value of 600 B.T.U.

A horizontal line drawn through the ordinate of 600 B.T.U. cuts the curve *A*, of Plate XIV., at a point corresponding to a temperature of the inlet water of 72° F. and which is also the point of inflection of the curve. Thus it is plain that, if the water supplied to the calorimeter be at room temperature, and the products of combustion leave at room temperature, there is a thermal balance. The interpretation of the curve having a point of inflection is that at the point of inflection the function changes from a gain to a loss, and it is apparent that the true heating value of the gas from Plate XIV. is 600 B.T.U.

It may happen that the water supply available is not at room temperature, and thus an error would be made in determining the heating value. It would be convenient if a simple correction could be applied, or if the equation of the curve *A*, on Plate XIV., could be obtained. This curve has the form of a cubical parabola whose general equation is $-y = \frac{x^3}{a}$ where (y) = the ordinate, (x) the abscissa and (a) the parameter. By a proper choice of a value for (a) the curve can be made to assume a variety of shapes. If the origin of the curve be at the point where the ordinate for B.T.U. rises from the point of the temperature of the inlet water corresponding to the room temperature, and if X = F° difference between the room temperature and inlet water, then (y) would give the B.T.U. to be added to or subtracted from the value found. For the curve A, Plate XIV., which represents fairly average conditions, the value of $(a) = 17.75$.

Suppose that a test for heating value is made with the room at 70° F., the inlet water at 60° F. Then $x = -10°$, $a' = 315$, and $+y = \frac{+1{,}000}{315} = +3.16$ B.T.U. which must be subtracted. If the inlet water were at 80° F., then $x = +10°$ and $-y = \frac{1{,}000}{315} = 3.16$ B.T.U., which means that 3.16 B.T.U. must be added to the value found.

The equation $-y = \frac{x^3}{315}$ fits the curve A, Plate XIV., exactly above the room temperature, but does not fit well at more than about 12° F. below room temperature, and thus there is a limitation. A correction factor at best is undesirable, and it would be preferable if the air, gas, products of combustion and water used in the test were all at the same temperature.

The above equation holds, of course, only for a room temperature of 70° F. If the room temperature is much lower the curve will be straighter than at 70° F., and should the room temperature be much higher the curve will have about the same shape, but will bend down faster at temperatures above the room temperature. In a general way the curve will change its direction in approximately the same degree as vapor tension curves do.

The Effect of Humidity on Heating Values.

Assuming the air temperature of 70° F. and the barometer of 28.7 inches, which were the mean during tests, we find 1 cubic foot of saturated gas at 70° — 28.7″ would be equivalent to .976 cubic feet of dry gas, and it would, therefore, carry .024 cubic foot of water vapor. This .976 cubic foot dry gas would require at its temperature 5.406 cubic feet dry air, which would be equivalent to 5.406 cubic feet at 0 per cent. relative humidity to 5.547 at 100 per cent. humidity. The difference between these two would be the cubic feet of water vapor carried by the air required for combustion. It would be equivalent to 0 cubic foot at 0 per cent. relative humidity to .141 cubic feet at 100 per cent. humidity or saturation, measured at 70° and a 28.7 barometer. The sum then of the vapor carried by the gas plus the vapor carried by the air would be .024 cubic foot at 0 per cent. to .165 cubic foot at 100 per cent. Reducing this to 60° and 30″ gives .02252 to .1548 cubic foot, or, expressed in pounds, would be .001072 for 0 per cent. to .007375 at 100 per cent.

The actual volume of dry gas burned has been .976 cubic foot. From former calculations 5.219 cubic feet of dry products of combustion are obtained from 1 cubic foot of saturated gas. This is equivalent to 5.358 cubic feet saturated. The difference (or .139) is the volume of water vapor carried out by the products of combustion measured at 70° and 28.7 barometer. Reducing this to 60° and 30″ gives us .1305 cubic foot. This would weigh .00621 pound, which is the weight of water vapor carried out of the calorimeter by the products of combustion. Subtracting from this quantity, which is constant, as the products always leave saturated, from the pounds of water vapor carried into the calorimeter by the air and gas under the different conditions assumed, we have the following quantities of water vapor gained or lost by the calorimeter; that is, — .00514 pound was lost at 0 per cent. and + .00117 pound was gained at 100 per cent. Multiplying this mass of water vapor by its heat of vaporization at 70° we have the actual heat in B.T.U. which was gained or lost by the calorimeter by the combustion of 1 cubic foot saturated gas at 70° and 28.7 barometer.

Correcting to 60° and 30″.

Humidity.	Corrected.
0 per cent	— 5.90
25 "	— 4.155
50 "	— 2.130
75 "	— .303
100 "	+ .858

The curve as shown by actual reading is given in Plate XVI. The calculated curve is shown in Plate XVIa.

Tests of Other Calorimeters.

Since the above tests were concluded it was decided by the Committee to investigate still further the several calorimeters that had appeared on the American market, and were being used in commercial practice. The instruments brought most forcibly to our attention were the Graefe calorimeter, designed by Dr. Graefe, of Germany, and the 1909 model of the Sargent Steam Meter Company, Chicago. This second instrument being the result of the changes made to the improved type calorimeter, presented in 1908, and was apparently designed to meet the recommendations made by the American Gas Institute Committee on Calorimetry in 1908.

It was understood that there were several other calorimeters in process of development, among which were the Doherty, the Parr and the Lucke. However, none of these instruments was available to the Committee. No attempt was made to gather various calorimeters for testing purposes, as the investigation this year was more to determine the effect on heating value of the many varying conditions likely to arise in commercial operation.

The Committee, nevertheless, would have looked into the merits of any instrument if it had found them in use in any of our operating companies, as it did with the Graefe calorimeter, which was called to its attention during the last annual meeting. This instrument was supplied to fill a long felt want of a cheap calorimeter to give quick and approximate readings; in this it failed, while being cheap and supposedly quick in operation it gave results that may not even be considered approximate, and for commercial purposes its use is to be

One Cubic Foot of Saturated Gas at 70° F.

1 Contains Cubic Feet of Dry Gas.	2 Carries Cubic Feet of Aqueous Vapor.	3 Requires Cubic Feet of Dry Air for Combustion.	4 Yields Cubic Feet of Dry Products of Combustion.	5 Equivalent Volume Saturated Products of Combustion.	6 Carries Aqueous Vapor in Products of Combustion.	7 Equivalent Aqueous Vapor at 60° — 30″
.976	.024	5.406	5.219	5.358	.139	.1305

Relative Humidity.	Moist Air for 1 Cu. Ft. Gas Cu. Ft.	Aqueous Vapor in Air at 70° 28.7″ Cu. Ft.	Total Moisture Gas and Air 60° — 30″ Cu. Ft.	Aqueous Vapor Carried in Pounds.	Aqueous Vapor Carried out Pounds.	Aqueous Vapor Retained or Given up Pounds.	Heat in Aqueous Vapor 70° 29.7″ B.T.U.	Heat in Aqueous Vapor 60° — 30″ B.T.U.
0 per cent	5.406	.000	.024	.001072	.00621	.00514	—5.474	—5.90
25 "	4.441	.035	.059	.002637	.00621	.00357	—3.805	—4.155
50 "	5.480	.074	.098	.00438	.00621	.00438	—1.950	—2.130
75 "	5.515	.109	.133	.005947	.00621	.00595	—0.277	—0.303
100 "	5.547	.141	.165	.007375	.00621	.00738	+0.786	+0.858

avoided in all instances, as will be seen from the data of results obtained in a test submitted below.

THE SARGENT CALORIMETERS.

The Sargent calorimeters which were obtained for these tests had no serial numbers so were designated as No. 1, belonging to the Chemical Engineering Department of the University of Wisconsin, and No. 2, belonging to the United Gas Improvement Company, of Philadelphia. These instruments were materially different from the preceding models investigated last year, the entire calorimeter being made of metal with the outside casing nickeled and polished.

Weir overflows are located at both the inlet and outlet water supply, the weirs being detachable from the body of the calorimeter. Both thermometers are at the same height, and from the point where the inlet thermometer is inserted a pipe leads the water to the bottom of the calorimeter. A cock with a graduated dial serves to regulate the water entering the calorimeter.

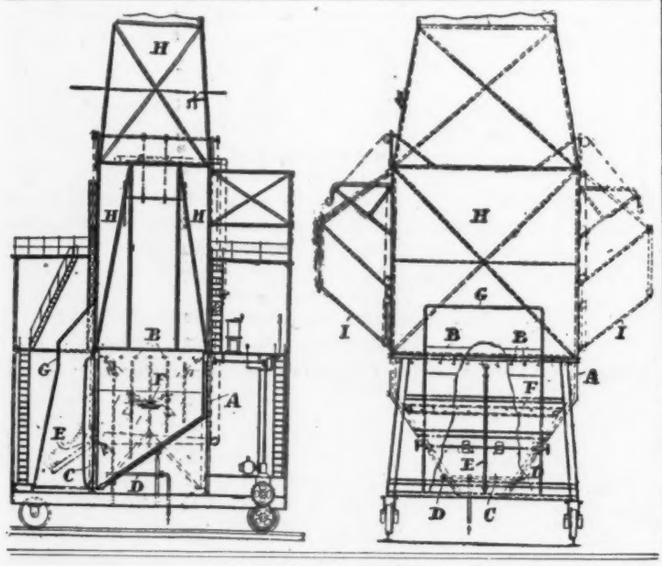
The water capacity of the calorimeter has been reduced somewhat over previous Sargent models, being now about 3.6 pounds, which is about equal to that of the Junkers. The burner has also been improved by the addition of a regulating cock.

(To be Continued.)

The Krause Plan of Quenching Incandescent Coke.

The *Journal of Gas Lighting* reports that on June 28th last, English Letters Patent were granted to Mr. E. H. H. Krause, of Hamburg, Germany, for a device for quenching incandescent coke. In describing it our contemporary says the invention is particularly adapted for dealing with coke in large quantities—in retorts working with large charges—in the trough of a traveller movable on rails in front of the retorts. In such case the walls of the quenching trough are apt to be damaged by excessive heat; and it has already been suggested to make the lateral walls of the trough hollow and to cool hem by water circulation—the upper walls having previously been n the form of a hood above the trough and provided with a longitudinal slot through which water contained therein could flow on to he coke in the trough. According to this invention, however, the water jacketed quenching trough is of special construction, and one or more water containing transverse beams are provided within the rough having openings from which the core of the coke in the trough s sprayed "so as to insure the most thorough and rapid quenching thereof."

In the construction illustrated, the quenching trough *A* is mounted



Krause's Coke Quencher.

in the center of the movable traveller in front of the retorts. The lateral walls, as well as the bottom of the trough, are formed double, and adapted to have water circulated through them for cooling purposes. The lateral walls are stiffened inside by ribs, which, however, are of such construction that the water used for cooling the walls can freely flow through the hollow space of the walls. The trough is open at top, and openings *B* are formed in the upper portions of the side walls through which cooling water can pass into the interior. The wall on the left-hand side in the section is provided at its lower end with a rotatable discharge door *C*, which also has double walls and can be opened or closed at will from the central platform of the traveller by means of a sprocket and chain gear so as to empty the contents of the trough. Water is supplied to the walls and the bottom of the trough through a pipe *D* leading into the walls of the trough; while the hollow door *C* is supplied with water by means of a flexible pipe *E* connected to the upper portion of the corresponding lateral wall. The door is provided near its upper end with openings whereby the coke in the lower portion of the trough, or falling from it, is sprinkled with water.

There is provided in the interior of the trough a single hollow crossbeam *F*, to which water is supplied through pipes from the hollow lateral walls; this water passing through lateral openings in the beam to the heart of the mass of coke in the trough. The beam is at the same time utilized as a baffle, since it divides the coke falling on it from the retort into the trough, and thus assists its quenching. In front of the lateral wall of the trough which has the discharge door, a partition *G* is provided at the required distance, forming an exhaust passage for the steam or fumes, the upper portion of which opens into the usual central tower-like chimney *H* of the apparatus, through which steam generated during the extinction of the coke is carried upwards, "thus protecting the attendants from danger."

The transfer of coke from the retorts to the quenching trough is effected by means of shoots *I* arranged at one or both sides of the traveller and opening into the trough. In operation, the coke as discharged will be quenched all over its upper surface by water from the openings *B* in the lateral walls; its central portion or core being simultaneously subjected to the action of the water from the openings in the crossbeam *F*, and its lower portion by the water escaping through the openings in the water cooled door *C*. Owing to the coke being simultaneously extinguished throughout, "quenching takes place in a rapid and thorough manner," on the other hand, "owing to the cooling of all the walls, as well as of the bottom and discharge door of the trough, the latter is not excessively heated by the incandescent coke, and is not therefore damaged."

Meeting Times of the Various Gas Associations.

American Gas Institute.—Annual meeting, October, 1910. Atlantic City, N. J. Officers: President, Wm. H. Bradley, N. Y., City; Secretary, A. B. Beadle, 29 West 39th street, N. Y. City.

Canadian Gas Association.—Annual meeting, June, 1909. Hamilton, Ont Officers: President, J. S. Norris, Montreal, P. Q.; Secretary and Treasurer, A. W. Moore Woodstock, Ont.

Empire State Gas and Electric Association.—Annual meeting, Nov., 1910. New York City. Officers: President, C. R. Huntley, Buffalo, N, Y.; Secretary, C. H. B. Chapin, 29 W. 39th street. New York City.

Guild of Gas Managers of New England.—Annual meeting, December. Young's Hotel, Boston; monthly meeting, second Saturday. Officers: President, A. K. Quinn; Newport, R. I.; Secretary, Walter G. Africa, Manchester, N. H.

Illinois Gas Association.—Annual meeting, time, March 18, 1910, Chicago, Ills. Officers: President, E. G. Schmidt, Springfield, Ills.; Secretary-Treasurer, C. B. Strohn, Elgin, Ills.

Illuminating Engineering Society.—Annual meeting, January 14, 1910. Meetings of Sections, monthly. President, W. H. Gartley, Philadelphia, Pa.; Secretary, Preston S. Millar, 29 W. 39th street, N. Y. City. Sections: New York: Secretary, Albert J. Marshall, 227 Fulton street. New England, Secretary, L. D. Gibbs, 39 Boylston street, Boston, Mass. Philadelphia, Secretary, F. N. Morton, Broad and Arch streets. Chicago, Secretary, T. R. Beebe, 157 Michigan avenue,

Indiana Gas Association.—Annual meeting, January 19, 1910, Indianapolis, Ind. Officers: President, J. W. Dunbar, New Albany, Ind.; Secretary-Treasurer, Philmer Eves, Indianapolis Gas Company, Indianapolis, Ind.

Iowa District Gas Association.—Annual meeting, time, June 23, 24, 25, 1910, Sioux City, Ia. Officers: President, Geo. H. Waring, Omaha, Neb.; Secretary and Treasurer, G. I. Vincent, Des Moines, Ia.

Kansas Gas, Water and Electric Light Association.—Annual meeting, time, ———— Wichita, Kas. Officers: President, W. A. Scothorn, Hutchinson, Kas.; Secretary and Treasurer, J. D. Nicholson, Newton, Kas.

Michigan Gas Association—Annual meeting, time, September, 1910; ———— Officers: President, B. O. Tippy, Grand Rapids, Mich.; Secretary-Treasurer, Glenn R. Chamberlain, Grand Rapids, Mich.

Missouri Electric Light, Gas, Water Works and Street Railway Association.—Annual meeting, April 14, 15 and 16, 1910; Jefferson City, Mo. Officers: President, W. A. Bixby; Secretary and Treasurer, C. L. Clary, Sikeston, Mo.

National Commercial Gas Association.—Annual meeting, third week in October, 1910: Boston. Officers: President, E. N. Wrightington, Boston; Secretary, Lucius S. Bigelow, 106 Fulton street, New York City.

Natural Gas Association.—Annual meeting, May 17, 18 and 19, 1910; Oklahoma City, Okla. Officers: President, William H. McKenzie, Kansas City, Kas.; Secretary, T. C. Jones, Delaware, O.

New England Gas Association.—Annual meeting, third Wednesday in February; Boston. Officers: President, Walter G. Africa, Manchester, N. H.: Secretary-Treasurer, N. W. Gifford, East Boston, Mass.

Oklahoma Electric Light, Railway and Gas Association.—Annual meeting, May 18, 19 and 20, 1910; Oklahoma City. Officers: President, F. H. Tidman, Oklahoma City, Okla.; Secretary-Treasurer, Galen Crow, Guthrie, Okla.

Pacific Coast Gas Association.—Annual meeting, ————, 1910, Los Angeles, Cal Officers: President, W. B. Cline, Los Angeles, Cal.; Secretary-Treasurer, John A. Britton, 925 Franklin street, San Francisco, Cal.

Pennsylvania Gas Association.—Annual meeting, April 13, 1910, Easton, Pa. Officers: President, E. G. Holzer, Easton, Pa.; Secretary-Treasurer, William H. Merritt, Lebanon, Pa.

Society of Gas Lighting.—Annual meeting, Dec. 9, 1909; monthly meeting, second Thursday. Place, New York City. Officers: President, Fred. S. Benson; Secretary, George G. Ramsdell, 1123 Broadway, New York.

Southern Gas Association.—Annual meeting, Feb. 16, 1910, Chattanooga, Tenn. Officers: President, R. C. Congdon, Atlanta, Ga.; Secretary-Treasurer, James Ferrier, Rome, Ga.

Southwestern Electrical and Gas Association.—Annual meeting. ———— ————, 1910, Beaumont, Tex. Officers: President, R. B. Stichter, Dallas, Tex.; Secretary's office, 300 Commerce street, Dallas, Tex.

Wisconsin Gas Association.—Annual meeting, May 11 and 12, 1910, Milwaukee, Wis Officers: President, R. B. Brown, Milwaukee, Wis.; Secretary-Treasurer, H. H. Hyde, Racine, Wis.

Recent Patent Issues.

Prepared for the AMERICAN GAS LIGHT JOURNAL by ROYAL E. BURNHAM, solicitor of patents and counselor in patent causes, 833 Bond Building, Washington, D. C., from whom illustrations and specifications of any patent mentioned below may be obtained for 10 cents.

945,332. Process of Obtaining Ammonia from Gas. H. Koppers, Essen-on-the-Ruhr, Germany.

945,536. Gas Burner. E. C. Hock, Pittsburgh, Pa.

945,715. Apparatus for Manufacture of Gas. A. M. Gow, Edgewood Park, Pa., assignor, by mesne assignments, to the Westinghouse Machine Company.

Items of Interest
FROM VARIOUS LOCALITIES.

AT the annual meeting of the Gage County (Neb.) Gas, Light and Power Company, of Beatrice, Neb., the report showed that the Company had enjoyed a fairly prosperous year. The Directors elected were Messrs. E. C. Guthery, C. S. Eaton, A. F. House, W. D. Parlin, J. J. Newitt, Sam. Rineker and R. R. Kyd. At a subsequent meeting of the Board the following organization was perfected: President, C. S. Eaton; Vice-President, R. R. Kyd; Secretary-Treasurer, W. D. Parlin; Assistant Secretary-Treasurer, J. J. Newitt. Mr. Kyd retires from the active management of the Company, to be succeeded therein, the 1st prox., by Mr. Newitt. The latter also succeeds Mr. Ed. S. Miller (resigned, to be retired). The payment this year to the city on royalty account (3 per cent. on the gross receipts) amounted to $810. Last year the payment was $509 on like account.

ABOUT 3 years ago Mr. Henry I. Lea started in as Consulting Engineer, having in view the gas field as his particular cultivating spot. Since then, in his quarters in the famous "Rookery Building," Chicago, he has been engaged on 41 different consulting jobs in the gas line, 21 of which were in different States of the Union. All of which rather goes to show that Mr. Lea knew well what he was about when he hung out that separate shingle in "The Rookery."

MR. GEORGE OSTEN has been appointed General Manager of the Norfolk (Neb.) Light and Fuel Company, vice Mr. T. H. Fulton, whose resignation was prompted by the wish to engage in another branch of business.

MR. WILLIAM G. ROCKEFELLER has been elected Vice-President of the Brooklyn Union (N. Y.) Gas Company, succeeding the late Mr. H. H. Rogers.

MR. E. D. FOX, who recently resigned the position of Superintendent to the Springfield (Mo.) Gas and Electric Company, will remain on the rolls until General Manager W. A. Bixby has selected a suitable successor.

SECRETARY STEINWEDELL informs us that the Gas Machinery Company is now being represented on the North Pacific Coast by the Northeast Gas Equipment Company, Portland, Ore.; and in California by Mr. Van E. Britton, whose headquarters are in 269 Monadnock Block, San Francisco.

REFERRING to the Gas Machinery Company reminds us that another contract recently awarded it has been completed. This work was the placing of a 10-foot diameter rotary scrubber in the plant of the Empire Coke Company, Geneva, N. Y. Mr. E. H. Palmer, President of the Empire Coke Company, is operating this scrubber by means of electrical power, and is maintaining it for the recovery of benzol. The plant is being very efficiently managed under the careful supervision of Mr. Palmer.

"THE manufacturing plant of the Brandon (Canada) Gas and Power Company was first put at work November 30th last, and the service has since been carried on without delay or difficulty. Mayor Adolph was the first stoker (the plant is of the coal gas type) and the works employees and several of the Councilmen greeted him with cheers when, with a gayly bedecked shovel, he put the first charge of coal into one of the glowing retorts. It is needless to add that as none of Chief Engineer Harper's men could be induced to swing such a toy, the Engineer handed the shovel over to the Mayor for keeps; gently adding these words to the presentation as a whole: 'Mr. Mayor, we present you with this token as a reminder of the fact that at least once in your life you did some laborious work.' The plant is located on Park and Rideau streets and Pacific avenue, and it is well fitted for its purpose, and the residents seem to appreciate that fact by their demands upon it for service. By-the-way, Brandon is the second city between Winnipeg and the Coast to have a gas works.—B. A."

"E. P. C.," writing from Pasadena, Cal., under date of the 6th inst., incloses the following: "The Southern California Edison Power Company has secured a site at Long Beach, Cal., on which to construct what is said will be the biggest steam power plant west of Chicago. The site purchased is on the inner harbor, just north of the Salt Lake reservation. Work will begin within a month. The first section of the plant to be constructed will be housed in a structure 300 feet wide by 700 feet long. Two big turbine engines will be installed, capable of generating 30,000-horse power. The structure will be of concrete, and, with all machinery placed, will cost $2,100,000. It is expected to complete the plant within the next 2½ years. When finished it will have a horse power output of 100,000."

THE merger of gas companies in South New Jersey, that eventuated in the formation of the New Jersey Suburban Gas Company, includes 7 heretofore separate concerns, doing business in 21 separate towns. The links in the chain were originally known by these titles: The Pitman, Glassboro and Clayton, the Woodbury Heights, the Vineland, the Williamstown, the Elmer, the Laurel Springs, Magnolia and Clementon and the East Greenwich Gas Companies.

MAYOR AVERY, of course, reappointed Mr. William H. Snow as Manager of the Holyoke (Mass.) Gas and Electric Light division of the public works' system of the named city.

MR. C. E. WAKEMAN, who recently resigned the post of General Manager to the Glens Falls (N. Y.) Gas and Electric Light Company, will assume his new position, as General Manager of the electric plant at cape Girardeau, Mo.

AT the annual meeting of the shareholders in the St. Albans (Vt.) Gas Light Company the officers elected were: President, W. N. Maynard; Vice-President, Lee S. Tillottson; Treasurer, E. K. Dunbar; Secretary, Fred. J. Sisoo.

THE Massachusetts State Board of Gas and Electric Light Commissioners has prepared several recommendations for legislative consideration during the current session of the Legislature. Some of those are:

That the provisions of Section 41, of Chapter 110 of the revised laws, be so amended that gas companies may not engage in the supply of electricity by unanimous consent of their stockholders, but only as otherwise provided in the existing law, and that electricity supply companies shall be authorized to supply gas in only the same manner that gas companies are now authorized to supply electricity.

That public service corporations be excluded from the provisions of the law permitting corporations organized under general laws or created by special charter to extend or remove their business to any other city or town in the commonwealth.

The board gives its most earnest indorsement to a continuance of the policy of the commonwealth in relation to the declaring of dividends by corporations, and believes that experience has demonstrated the wisdom and value of the statute, which reads: "No tele-

graph, telephone, gas light, electric light, steam railroad, street railway, aqueduct or water company established under the laws of this commonwealth shall declare any stock or scrip dividend or divide the proceeds of the sale of stock or scrip among its stockholders."

MR. FRED. D. STREETER has resigned his position with the North Adams (Mass.) Gas Light Company to accept the position of Master Mechanic at the Windsor Print Works.

MR. C. F. BRUNT, who has managed the Waterloo (N. Y.) plant of the Inter-Urban Gas Company since 1902, has been appointed Superintendent of the Company's offices in Geneva, N. Y., succeeding Mr. Edward S. Seybolt, who has been appointed Manager of the Portsmouth (N. H.) works.

GENERAL MANAGER HEWITT, of the Consumers Gas Company, of Toronto, Ont., is out with a notification that 10,000 shares of the Company's stock (new issue) will be sold at auction, at the rooms of C. J. Townsend, 68 King street, East, at noon of April 5th.

MR. J. A. MAYERS informs us that the Cruse-Kemper Company has been awarded the contract for the construction of a storage holder on the plant that is being constructed by the Terhune-Warner-Sawyer syndicate at Goldsboro, N. C.

MR. T. B. FOSTER, writing from Denver, Col., under date of the 5th inst., incloses the following respecting the shocking death of Mr. James F. Klug, only recently appointed Superintendent of the Pueblo (Col.) Gas and Fuel Company: "Mr. J. F. Klug was drowned while skating over Lake Minnequa, Pueblo, the afternoon of the 2d inst. He was skating backwards and slid into an open patch of water near the intake of the Lake. The drowning was witnessed by a number of persons, and many rushed to his rescue, but before anyone could reach the spot he had disappeared beneath the icy water. Wm. Hayes, watchman at the Lake, secured a boat and, by means of a grappling hook, succeeded in recovering the body within about one-half hour after the accident. Life, however, was extinct, although every effort was tried to resuscitate him for more than 2 hours. Deceased came here the 6th ult. to take the position of Superintendent of the Pueblo Company, his former business connection having been in Knoxville, Tenn. He was 24 years of age and unmarried. He attended the School of Instruction conducted in Denver, Col., by the Denver Gas Company, and having completed the course, he went to Knoxville, there to finish out a course of practical instruction. This completed, he was called to Pueblo, assuming his duties the 1st inst., succeeding Mr. W. A. Bertke, who was recently called to the Spokane works."

"C. B. S.," writing from Elgin, Ills., under date of the 10th inst., says: "Mr. Charles D. Slimpin, for the past 5 years Chief Clerk in the office of the Western United Gas and Electric Company, Elgin, Ills., left here January 8th, to become Manager of the Du Quoin (Ills.) Light, Heat and Power Company. He was presented with a leather travelling bag by his fellow employees, who, together with all his friends, wish him abundant success in his new position."

AT the annual meeting of the Petoskey and Bay Shore (Mich.) Gas Company the following officers were elected: Directors, Sidney F. Stevens, R. W. Irvin, W. J. Stuart, C. E. Tarte, George T. Kendall, J. T. Hirschman and H. T. Heald; President, Henry T. Heald; Vice-President, J. T. Hirschman; Secretary and Treasurer, W. J. Stuart.

MR. GODFREY PATTERSON, counsel for the stockholders and creditors of the Bay State Gas Company, during the litigation that dragged over so lengthy a period, died at his home in Orange, N. J., the morning of the 6th inst. He was in his 77th year.

THE betterments carried out on the plant of the Dekalb-Sycamore (Ills.) Gas Company, under the capable supervision of Manager Davidson, are about completed. The main items in the construction were: An up-to-date water gas set and a storage holder up to retaining 50,000 cubic feet—the latter is equipped with a Connelly governor.

MR. ROBT. L. MIDDLETON, JR., Secretary and General Manager of the Georgetown (Wash.) Gas Light Company, was united in marriage to Miss Minnie B. Devoy, the morning of the 28th ult., in the home of the bride's parents, 24 East Silver street, Westfield, Mass. The ceremony was performed by Rev. Walter H. Commons, of the Second Congregational Church. After the wedding a breakfast was served in the home of the bride's parents. Mr. and Mrs. Middleton, on their return from an extended trip through the South, will make their home in 1411 Tenth street, Northwest, Washington.

THE Beal syndicate has agreed to supply gas to the settlement of Atlantic Highlands, N. J., piping the supply over from the plant of the Standard Gas Company, Matawan, N. J. The rate agreed on was $2 per 1,000, gross; net, $1.75. It is possible that the piping will not be done until next fall.

THE proprietors of the Wilmington (Del.) Gas Company have increased its standing reward, for testimony which will result in the conviction of thieves who rob the coin boxes of prepayment meters, to $100 per case. Hitherto the reward was $50.

MR. W. R. ELDER, of Three Rivers, Mich., is the one selected to succeed Mr. Chas. Foutz, as Superintendent of the Defiance Gas and Electric Company, Defiance, O.

MR. LUTHER WARNER WOODWARD, whose resignation from the service of the North Adams (Mass.) Gas Light Company last November terminated a service covering over 2 score years, died at his home in North Adams the morning of the 6th inst. He was in his 72d year, having been born in Woodford, Vt., March 16, 1838. He took charge of the North Adams plant April 1, 1867, prior to which time he had been engaged in construction and superintendence.

THE proprietors of the Shenandoah (Ia.) Gas Company seemingly have found that their conversion, some two or three years ago, of an acetylene station centrally operated plant into an up-to-date water gas plant, was in line with good practice. This we are led to believe from the fact that the output has gone to such a point as to render the existing apparatus inadequate. They now propose to expend $25,000 in plant enlargement, the proposition including a 2-lift holder.

THE authorities of Seaford, Del., are considering the advisability of granting a franchise under which a plentiful supply of artificial gas shall be guaranteed the residents.

IN sequence with the profit-sharing plan that exists between the New Haven (Conn.) Gas Company and its employees, the latter (up to the 8th inst.) were credited with the ownership of 607 shares The last distribution was made the 6th inst., which resulted in the awarding of 78 shares.

Illumination Glare.

The *Electrical World* says it is coming to be realized more and more in illuminating engineering circles that not only must the sources of light be considered, but also the surfaces illuminated. For example, when the page of a book is illuminated, one is enabled to read what is on it by the difference in the reflecting power of the white page and the ink with which the letters are printed or written. When too much light intensity is on the paper, so that the surface of the paper reflects too much into the eye of the reader, the eye is partially blinded and cannot read. The intensity of illumination which is sufficient to cause difficulty in reading depends on the illumination of the surroundings. An intensity of illumination that would be blinding on a page in a dark room would be quite tolerable in the open on a bright day. It is a matter of contrast rather than absolute value. It has been shown that outdoors with a partially illuminated sky surrounding the observer there is required a much higher intensity of illumination in foot candles to read instruments than is required by night. This is undoubtedly due to the effect of the surrounding sky illumination on the eye.

At the present time this matter of regular reflection from the objects illuminated which causes such a glisten as to interfere with the case of seeing is justly receiving more attention. Much has been heard about the bad effects of lamps which are not properly shaded when they are placed above the users. However, as a matter of fact, much of the trouble may be from below, from the glare reflected from the paper, metal or what not that may be worked upon. The glare from the work from below is merely the reflection of the glare of the lamps from which the illumination is obtained. The glare from the page of glazed paper is the reflection from one particular lamp placed relatively near to the paper. The nearer the lamp is placed to the paper, the more pronounced is the trouble. It is for this reason that systems of general illumination, as against a lot of individual lamps for each person, are coming into use. The individual lamp over each desk or workman's bench is tolerably sure to make trouble by reflection from the work at certain angles, and it is not always easy for the worker to avoid those angles. To prevent trouble from the reflection from below, the light must fall on the work from a number of lamps or from large diffusing surfaces.

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MONDAY, JANUARY 17, 1910.

The Market for Gas Securities.

At noon of Friday (14th inst.) Consolidated sold at 155¼, which was then bid for 100 shares or more, with holders asking 156. There is no denying the fact that the market for it seems unmistakably weak, and shortly after noon (the hour of writing) there was every indication that the price might be radically cut during the balance of the day, several contracts for the short side evidently being at the hot point in the incubator. There is no good (or any) reason for this shrinkage in values. To the contrary, there is reason for better prices, prices well beyond these now ruling.

The antonyme of the situation is shown in Brooklyn Union, which is bid 161. Will any sane-minded investor think that, as at present rigged, Brooklyn Union Gas is worth more than Consolidated? Not that we have any intention of belittling the Brooklyn Company, which is worth well over the 161 bid. The gas share market in general, in keeping with the market on a whole, is all against the seller.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JANUARY 17.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked*
Consolidated Gas Co.	$73,177,000	100	155¼	156
Central Union Gas Co. — 1st 5's, due 1972, J. & J.	8,000,000	1,000	98	101
Equitable Gas Light Co.— Con. 5's, due 1932, M. & S.	1,000,000	1,000	—	105
Mutual Gas Co.	2,500,000	100	155	165
New Amsterdam Gas Co.— 1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	100	101¼
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	37	43
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	—	100	101
New York and East River— 1st 5's, due 1944, J. & J.	3,500,000	1,000	104	107
Con. 5's, due 1945, J. & J.	1,500,000	—	97	101
Northern Union— 1st 5's, due 1927, J. & J.	1,250,000	1,000	94	100
Standard	5,000,000	100	—	75
Preferred	5,000,000	100	70	100
1st Mtg. 5's, due 1960, M. & N.	1,500,000	1,000	100	105
The Brooklyn Union	15,000,000	1,000	161	161½
1st Con. 5's, due 1948, M. & N.	15,000,000	—	95	99
Yonkers	200,650	500	130	—
Out-of Town Companies.				
Bay State	50,000,000	50	1	1½
" Income Bonds	2,000,000	1,000	—	75
Binghampton Gas Works	450,000	100	—	65
" 1st Mtg. 5's	500,000	1,000	90	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	8
Bonds, 5's	5,250,000	1,000	73	73½
Capital, Sacramento	500,000	50	—	35
Bonds (6's)	150,000	1,000	—	—
Chicago Gas Co. Guaranteed Gold Bonds	7,000,000	1,000	104	106¼
Cincinnati Gas and Electric Co.	20,500,000	100	92	93
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	96	98
Columbus (O.) Gas Lt. & Heating Co.	1,632,750	100	90½	91
Preferred	3,026,500	100	75½	80
Consumers, Toronto	2,000,000	0	200	204
Consolidated, Baltimore	11,000,000	100	—	105
Mortgages, 6's	3,000,000	—	—	112
Chesapeake, 1st 6's	1,000,000	—	—	—
Equitable, 1st 6's	910,000	—	—	—
Consolidated, 1st 5's	1,490,000	—	—	112
Consolidated Gas Co. of N. J.	1,000,000	100	15	17
Con. Mtg. 5's	880,000	1,000	92	95
Bonds	75,000	—	—	100
Denver Gas and Electric	458,000	—	102	105
Detroit City Gas Co	5,000,000	50	—	50
" Prior Lien 5's	4,619,000	1,000	97	100½
Detroit Gas Co., 5's	381,000	1,000	75	80
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	—	101
Essex and Hudson Gas Co.	6,500,000	—	39	40
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Light Co., 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	—	112	113½
" Bonds, 5's	10,500,000	—	108	108½
Indianapolis	2,000,000	—	60	70
" Bonds, 5's	2,650,000	—	104½	105
Jackson Gas Co.	250,000	50	82	—
" 1st Mtg. 5's	200,000	1,000	97	100
Kansas City Gas Light Co., of Missouri	5,000,000	100	—	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede Gas Co., St. Louis.	10,000,000	100	104	105
Preferred	2,500,000	100	—	98
Bonds	10,000,000	1,000	104	—
Lafayette Gas Co., Ind.	1,000,000	100	—	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	143	145
Madison Gas and Electric Co.				
" 1st Mtg. 6's	350,000	1,000	106	108½
" 6 per cent. scrip, due 1910	100,000	25	60	60½
Massachusetts Gas Companies, of Boston	25,000,000	100	79½	80
Preferred	25,000,000	100	94½	95
Montreal Gas Co., Canada	2,000,000	100	218	218½
Nashville Gas Light Co.	1,000,000	100	110	—
Newark, N. J., Con. Gas Co.	6,000,000	—	56	58
Bonds, 6's	6,000,000	—	137	138
New Haven Gas Co.	2,000,000	25	200	—
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	113¾	114¼
1st Mortgage	20,100,000	1,000	—	—
2d "	2,500,000	1,000	104	—
Rochester Gas & Electric Co.	2,150,000	50	88	—
Preferred	2,150,000	50	118	—
Consolidated 5's	2,000,000	—	104½	105½
San Francisco Gas Co., Cal.	15,500,000	—	—	—
St. Joseph Gas Co.— 1st Mtg. 5's	751,000	1,000	100	102
St. Paul Gas Light o.	1,500,000	100	45	47
1st Mortgages, 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112¾	115
General Mortgage, 5's	2,465,000	1,000	90	95
Syracuse Gas o., N. Y.	1,975,000	100	50	55
Bonds	2,047,000	1,000	100	104
Washington (D. C.) Gas Co.	1,600,000	200	391	392
1st Mortgage, 6's	600,000	—	—	—
Western Gas o., Milwaukee	4,000,000	—	—	—
Wilmington (Del.) Gas o.	600,000	50	361	—

Advertisers' Index.

New advertising, or changes in standing ads., to assure attention the issue following their reception, must be in hand on Wednesday.

GAS ENGINEERS. Page

Albert Ladd Colby, South Bethlehem, Pa. 114
Bartlett-Hayward Co., Baltimore, Md. 137
Cruse-Kemper Co., Philadelphia, Pa. 124
Davis & Farnum Mfg. Co., Waltham, Mass. 136
Drakes Limited, Halifax, England. 114
Economical Gas Apparatus Construc. Co., Toronto, Ont. 128
Edwin E. Witherby, New York City. 114
Evens & Howard Firebrick Co., St. Louis, Mo. 68
Frank D. Moses, Trenton, N. J. 126
Fred Bredel Co., Milwaukee, Wis. 119
Frederick J. Mayer, New York City. 117
Fred. K. Wells, New York City. 128
Henry I. Lea, Chicago, Ills. 136
H. M. Byllesby & Co., Chicago, Ills. 136
Humphreys & Glasgow, New York City. 136
Improved Equipment Company, New York City. 118
Isbell-Porter Co., Newark, N. J. 124
Kerr Murray Mfg. Co., Fort Wayne, Ind. 129
Laclede-Christy Clay Products Co., St. Louis, Mo. 184
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. 122
Quintard Iron Works, New York City. 125
R. D. Wood & Co., Philadelphia, Pa. 138
The Gas Machinery Co., Cleveland, O. 116
The Stacey Mfg. Co., Cincinnati, O. 139
The United Gas Improvement Co., Philadelphia, Pa. 131
Western Gas Construction Co., Fort Wayne, Ind. 144
William A. Baehr, Chicago, Ills. 114

GAS WORKS APPARATUS AND CONSTRUCTION.

Bartlett-Hayward Co., Baltimore, Md. 137
Connelly Iron Sponge & Governor Co., New York City. 133
Continental Iron Works, Brooklyn, N. Y. 134
Cruse-Kemper Co., Philadelphia, Pa. 124
Davis & Farnum Mfg. Co., Waltham, Mass. 136
Deily & Fowler Mfg. Co., Philadelphia, Pa. 127
Economical Gas Apparatus Construc. Co., Toronto, Ont. 128
Evens & Howard Firebrick Co., St. Louis, Mo. 68
Fred Bredel Co., Milwaukee, Wis. 119
Gas Engineering Co., Trenton, N. J. 126
Humphreys & Glasgow, New York City. 136
Improved Equipment Company, New York City. 118
Isbell-Porter Co., New York City. 124
Kerr Murray Mfg. Co., Fort Wayne, Ind. 129
Laclede-Christy Clay Products Co., St. Louis, Mo. 132
Lloyd Construction Co., Detroit, Mich. 126
Quintard Iron Works Co., New York City. 125
R. D. Wood & Co., Philadelphia, Pa. 138
Riter-Conley Mfg. Co., Pittsburgh, Pa. 123
The Gas Machinery Co., Cleveland, O. 116
The Stacey Mfg. Co., Cincinnati, O. 139
The United Gas Improvement Co., Philadelphia, Pa. 121
Western Gas Construction Co., Fort Wayne, Ind. 144

PROCESSES.

Bartlett-Hayward Co., Baltimore, Md. 137
Economical Gas Apparatus Construc. Co., Toronto, Ont. 128
Fred Bredel Co., Milwaukee, Wis. 119
Humphreys & Glasgow, New York City. 126
Improved Equipment Company, New York City. 118
The Gas Machinery Co., Cleveland, O. 116
The United Gas Improvement Co., Philadelphia, Pa. 121
Western Gas Construction Co., Fort Wayne, Ind. 144

SCRUBBERS AND CONDENSERS.

Bartlett-Hayward Co., Baltimore, Md. 137
Continental Iron Works, Brooklyn, N. Y. 124
Cruse-Kemper Co., Philadelphia, Pa. 124
Davis & Farnum Mfg. Co., Waltham, Mass. 136
Economical Gas Apparatus Construc. Co., Toronto, Ont. 128
Evens & Howard Firebrick Co., St. Louis, Mo. 68
Fred Bredel Co., Milwaukee, Wis. 119
Isbell-Porter Co., Newark, N. J. 124
Kerr Murray Mfg. Co., Fort Wayne, Ind. 129
Quintard Iron Works, New York City. 125
R. D. Wood & Co., Philadelphia, Pa. 138
Riter-Conley Mfg. Co., Pittsburgh, Pa. 123
The Gas Machinery Co., Cleveland, O. 116
The Stacey Mfg. Co., Cincinnati, O. 139
The United Gas Improvement Co., Philadelphia, Pa. 121
Western Gas Construction Co., Fort Wayne, Ind. 144

PRODUCER POWER PLANTS.

Economical Gas Apparatus Construc. Co., Toronto, Ont. 128
R. D. Wood & Co., Philadelphia, Pa. 138

TAR AND CARBONIC ACID EXTRACTOR.

Bartlett-Hayward Co., Baltimore, Md. 137
Economical Gas Apparatus Construc. Co., Toronto, Ont. 128
Fred Bredel Co., Milwaukee, Wis. 119
Isbell-Porter Co., Newark, N. J. 124
Kerr Murray Mfg. Co., Fort Wayne, Ind. 129
The Gas Machinery Co., Cleveland, O. 116
The Stacey Mfg. Co., Cincinnati, O. 139
The United Gas Improvement Co., Philadelphia, Pa. 121
Western Gas Construction Co., Fort Wayne, Ind. 144

AMMONIA CONCENTRATORS.

Bartlett-Hayward Co., Baltimore, Md..... 137
Fred Bredel Co., Milwaukee, Wis..... 119
Michigan Ammonia Works, Detroit, Mich..... 114
The Gas Machinery Co., Cleveland, O..... 116
Western Gas Construction Co., Fort Wayne, Ind..... 144

GAS METERS.

American Meter Co., New York and Philadelphia..... 143
D. McDonald & Co., Albany, N. Y..... 131
Helme & McIlhenny, Philadelphia, Pa..... 143
John J. Griffin & Co., Philadelphia, Pa..... 95
Keystone Meter Co., Royersford, Pa..... 142
Maryland Meter and Mfg. Co., Baltimore, Md..... 142
Metric Metal Co., Erie, Pa..... 143
Nathaniel Tufts Meter Co., Boston, Mass..... 142
New York Improved Meter Co., New York City..... 142
Pittsburg Meter Co., East Pittsburg, Pa..... 122
Rotary Meter Co., New York City..... 141
Sprague Meter Co., Bridgeport, Conn..... 141

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia..... 143
D. McDonald & Co., Albany, N. Y..... 141
Helme & McIlhenny, Philadelphia, Pa..... 143
John J. Griffin & Co., Philadelphia, Pa..... 96
Keystone Meter Co., Royersford, Pa..... 142
Nathaniel Tufts Meter Co., Boston, Mass..... 142
New York Improved Meter Co. New York City..... 142
Pittsburg Meter Co., East Pittsburg, Pa..... 122
Sprague Meter Co., Bridgeport, Conn..... 141

PREPAYMENT METER ATTACHMENTS.

New York Improved Meter Co., New York City..... 142

WATER METERS.

Pittsburg Meter Co., East Pittsburg, Pa..... 122

GAS AND WATER PIPES.

Davis & Farnum Mfg. Co., Waltham, Mass..... 136
Donaldson Iron Co., Emaus, Pa..... 128
Economical Gas Apparatus Construc. Co., Toronto, Ont. 128
R. D. Wood & Co., Philadelphia, Pa..... 138

GAS COALS.

Berwind-White Coal Mining Co., New York and Phila. 134
Perkins Co., New York City..... 134
Westmoreland Gas Coal Co., Philadelphia, Pa..... 135

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., New York City..... 135

MAIN AND SERVICE LAYING.

Sullivan Bros., Flushing, N. Y..... 135

GAS TAPPING MACHINES.

George Light, Dayton, O..... 135
H. Mueller Manufacturing Co., Decatur, Ills..... 119

CANNEL COALS.

Perkins & Co., New York City..... 134

STOKING MACHINERY.

Fred Bredel Co., Milwaukee, Wis..... 119
G. A. Bronder, New York City..... 133
Laclede-Christy Clay Products Co., St. Louis, Mo..... 132
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 122

CONVEYORS—ALL KINDS.

Bartlett-Hayward Co., Baltimore, Md..... 137
Cruse-Kemper Co., Philadelphia, Pa..... 124
C. W. Hunt Company, New York City..... 136
Economical Gas Apparatus Construc. Co., Toronto, Ont. 128
Fred Bredel Co., Milwaukee, Wis..... 119
G. A. Bronder, New York City..... 133
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 129
The Gas Machinery Co., Cleveland, O..... 116
The Stacey Mfg. Co., Cincinnati, O..... 139
Western Gas Construction Co., Fort Wayne, Ind..... 144

CHARGING BARROWS & COAL WAGONS.

Davis & Farnum Mfg. Co., Waltham, Mass..... 136
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 129
The Stacey Mfg. Co., Cincinnati, O..... 139

GAS ENRICHERS.

Standard Oil Co., New York City..... 135

COKE CRUSHERS.

Bartlett-Hayward Co., Baltimore, Md..... 137
C. M. Keller, Columbus, Ind..... 135

GAS METER CONNECTIONS.

H. Mueller Manufacturing Co., Decatur, Ills..... 119

GAS COCKS.

H. Mueller Manufacturing Co., Decatur, Ills..... 119

GAS GAUGES.

The Bristol Co., Waterbury, Conn..... 128

GAS GOVERNORS.

Chaplin-Fulton Mfg. Co., Pittsburg, Pa..... 138
Connelly Iron Sponge & Governor Co., New York City. 133
Evens & Howard Firebrick Co., St. Louis, Mo..... 68
Isbell-Porter Co., Newark, N. J..... 124
Pittsburg Meter Co., East Pittsburg, Pa..... 122
Reynolds Gas Regulator Co., Anderson, Ind..... 133

CEMENTS.

C. L. Gerould, New Castle, Pa..... 132
Laclede-Christy Clay Products Co., St. Louis, Mo..... 132
Strassburger Bros., Chicago, Ills..... 132

RETORTS AND FIREBRICKS.

Baltimore Retort and Firebrick Co., Baltimore, Md... 132
Didier-March Co., New York City..... 117
Evens & Howard Firebrick Co., St. Louis, Mo..... 68
Fred Bredel Co., Milwaukee, Wis..... 119
Gas Bench Construction Co., St. Louis, Mo..... 125
Henry Maurer & Son, New York City..... 128
Improved Equipment Company, New York City..... 118
James Gardner, Jr., Co., Bolivar, Pa..... 134
J. H. Gautier & Co., Jersey City, N. J..... 132
Laclede-Christy Clay Products Co., St. Louis, Mo..... 132
Missouri Firebrick Co., St. Louis, Mo..... 132
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.... 122

INCLINED RETORTS.

Baltimore Retort and Firebrick Co., Baltimore, Md... 132
Didier-March Co., New York City..... 117
Evens & Howard Firebrick Co., St. Louis, Mo..... 68
Fred Bredel Co., Milwaukee, Wis..... 119
Gas Bench Construction Co., St. Louis, Mo..... 125
Improved Equipment Company, New York City..... 118
Laclede-Christy Clay Products Co., St. Louis, Mo..... 132
Parker-Russell Mining and Mfg. Co., St. Louis, Mo... 122

VERTICAL S'S.

Connelly Iron Sponge & Gov. Co. (Drake's [Eng.] System) 133
Didier-March Co., New York City..... 117
Evens & Howard Firebrick Co., St. Louis, Mo..... 68
Fred Bredel Co., Milwaukee, Wis..... 119
Gas Bench Construction Co., St. Louis, Mo..... 125
Improved Equipment Company, New York City..... 118
Laclede-Christy Clay Products Co., St. Louis, Mo..... 132
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. .. 122

REGENERATIVE FURNACES.

Baltimore Retort and Firebrick Co., Baltimore, Md.. 132
Bartlett, Hayward & Co., Baltimore, Md..... 137
Didier-March Co., New York City..... 117
Evens & Howard Firebrick Co., St. Louis, Mo..... 68
Fred Bredel Co., Milwaukee, Wis..... 119
Gas Bench Construction Co., St. Louis, Mo..... 125
Improved Equipment Company, New York City..... 118
J. H. Gautier & Co., Jersey City, N. J..... 132
Laclede-Christy Clay Products Co., St. Louis, Mo..... 132
Missouri Firebrick Co., St. Louis, Mo..... 132
Parker-Russell Mining and Mfg. Co., St. Louis, Mo... 122

SELF-SEALING MOUTHPIECE DOORS.

Bartlett-Hayward Co., Baltimore, Md..... 137
Continental Iron Works, Brooklyn, N. Y..... 134
Davis & Farnum Mfg. Co., Waltham, Mass..... 136
Fred Bredel Co., Milwaukee, Wis..... 119
Isbell-Porter Co., Newark, N. J..... 134
Improved Equipment Company, New York City..... 118
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 129
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 132
Quintard Iron Works, New York City..... 135
R. D. Wood & Co., Philadelphia, Pa..... 138
The Gas Machinery Co., Cleveland, O..... 116
The Stacey Mfg. Co., Cincinnati, O..... 139
Western Gas Construction Co., Fort Wayne, Ind..... 144

INCANDESCENT GAS LAMPS.

General Gas Light Co., Kalamazoo, Mich..... 131
Welsbach Company, Gloucester, N. J..... 130

BURNERS.

Wm. M. Crane Co., New York City..... 128

STREET LAMPS.

Thos. T. W. Miner, New York City..... 114
Welsbach Street Lighting Co., New York and Phila.. 130

GAS BLAST FURNACES.

American Gas Furnace Co., New York City..... 120

PURIFIERS.

Bartlett-Hayward & Co., Baltimore, Md..... 137
Connelly Iron Sponge & Governor Co., New York City. 133
Cruse-Kemper Co., Philadelphia, Pa..... 124
Davis & Farnum Mfg. Co., Waltham, Mass..... 136
Evens & Howard Firebrick Co., St. Louis, Mo..... 68
Isbell-Porter Co., Newark, N. J..... 124
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 129
Quintard Iron Works, New York City..... 125
R. D. Wood & Co., Philadelphia, Pa..... 138
The Stacey Mfg. Co., Cincinnati, O..... 139
The United Gas Improvement Co., Philadelphia, Pa... 131
Western Gas Construction Co., Fort Wayne, Ind..... 144

VALVES.

Bartlett-Hayward & Co., Baltimore, Md..... 137
Continental Iron Works, Brookln, N. Y..... 134
Davis & Farnum Mfg. Co., Waltham, Mass..... 136
Economical Gas Apparatus Construc. Co., Toronto, Ont. 128
Isbell-Porter Co., Newark, N. J..... 124
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 129
Ludlow Valve Manufacturing Co., Troy, N. Y..... 125
R. D. Wood & Co., Philadelphia, Pa..... 138
The Gas Machinery Co., Cleveland, O..... 116
The P. H. & F. M. Roots Co., Connersville, Ind..... 127
The Stacey Mfg. Co., Cincinnati, O..... 139
Western Gas Construction Co., Fort Wayne, Ind..... 144

(*Continued on page* 114.)

SPECIAL MEETING.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, December 9, 1909.

A Special Meeting of the Stockholders of The United Gas Improvement Company will be held at the office of the Company, Northwest Corner of BROAD AND ARCH STREETS, PHILADELPHIA, on Wednesday, Feb. 9, 1910, at 12 o'clock, noon, for the purpose of acting upon the subject of a proposed increase in the authorized capital stock of the Company from 1,009,467 shares, of the par value of $50 each, to 1,110,414 shares, of the par value of $50 each.

By order of the Board of Directors.

W. F. DOUTHIRT, Secretary.

The stock transfer books will be closed from 3 P.M., Jan. 28, 1910, until 10 A.M., Feb. 10, 1910.

1801-9

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Lecturer and Demonstrator of Cookery by Gas or Electricity,

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Second-hand gas apparatus in good order. Selling because outgrown. Ready for immediate delivery.

One 6-foot Tufts' Station Meter, Hinman Drum, 10-inch connections.
One 5-foot Tufts' Station Meter, Hinman Drum, 8-inch connections.
One Standard Washer Scrubber and Standard, with inlet and outlet valves, 10-inch connections.
One No. 3 P. & A. Tar Extractor, 8-inch connections.
Two 3-blade McKenzie Exhausters, 8-inch connections.

NEW BEDFORD GAS AND EDISON LIGHT COMPANY,
1798-tf NEW BEDFORD, MASS.

(Concluded from page 113.)

PURIFYING MATERIALS.

Connelly Iron Sponge & Governor Co., New York City 133
F. Behrend, New York City 124
The United Gas Improvement Co., Philadelphia, Pa. 131

EXHAUSTERS.

Connelly Iron Sponge & Governor Co.,New York City 133
Connersville Blower Company, Connersville, Ind. 140
Davis & Farnum Mfg. Co., Waltham, Mass. 136
Isbell-Porter Company, Newark, N. J. 124
Kerr Murray Mfg. Co., Fort Wayne, Ind. 129
Piqua Blower Co., Piqua, O. 125
The P. H. & F. M. Roots Co., Connersville, Ind. 127

HIGH PRESSURE GAS GOODS.

H. Mueller Manufacturing Co., Decatur, Ills. 119

PURIFIER AND SCRUBBER TRAYS.

Bartlett-Hayward Co., Baltimore, Md. 137
Cabot Mfg. Co., Hoboken, N. J. 135
Western Gas Construction Co., Fort Wayne, Ind. 144

PIPE LINE TOOLS.

H. Mueller Manufacturing Co., Decatur, Ills. 119

GAS PLANT TOOLS.

H. Mueller Manufacturing Co., Decatur, Ills. 119

GAS STOVES.

American Meter Co., New York and Philadelphia. 143
Keystone Meter Co., Royersford, Pa. 142
Maryland Meter & Manufacturing Co., Baltimore, Md. 142
Nathaniel Tufts Meter Co., Boston, Mass. 142

HOT WATER HEATERS.

Humphrey Co., Kalamazoo, Mich. 126

GASHOLDERS.

Bartlett-Hayward Co., Baltimore, Md. 137
Chicago Bridge and Iron Works, Chicago, Ills. 115
Continental Iron Works, Brooklyn, N. Y. 134
Cruse-Kemper Co., Philadelphia, Pa. 124
Davis & Farnum Mfg. Co., Waltham, Mass. 136
Delly & Fowler Mfg. Co., Philadelphia, Pa. 140
Economical Gas Apparatus Construc. Co., Toronto, Ont. 128
Kerr Murray Mfg. Co., Fort Wayne, Ind. 129
R. D. Wood & Co., Philadelphia, Pa. 138
Riter-Conley Mfg. Co., Pittsburgh, Pa. 123
The Stacey Mfg. Co., Cincinnati, O. 139
Western Gas Construction Co., Fort Wayne, Ind. 144

STORAGE TANKS.

Bartlett-Hayward Co., Baltimore, Md. 137
Davis & Farnum Mfg. Co., Waltham, Mass. 136
Quintard Iron Works, New York City. 125
The Stacey Mfg. Co., Cincinnati, O. 139
Western Gas Construction Co., Fort Wayne, Ind. 144

COKE OVEN ENGINEERS.

Albert Ladd Colby, South Bethlehem, Pa 114

PATENTS, TRADE-MARKS AND COPYRIGHTS.

Royal E. Burnham, Washington, D. C. 135

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

IMPROVED AMMONIA CONCENTRATOR.

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ANNOUNCEMENT.

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Central Foundry Co., Universal Pipe Department, New York.
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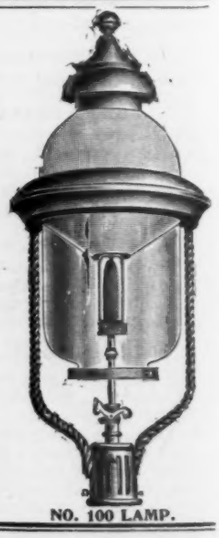

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Capacity, 1,200,000 Gallons. Height, 220 Feet.

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P. PLANTINGA, President W. E. STEINWEDELL, Secretary

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VALVES, CONNECTIONS,
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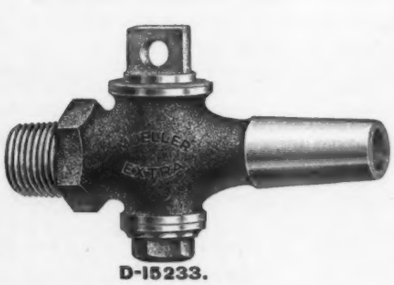

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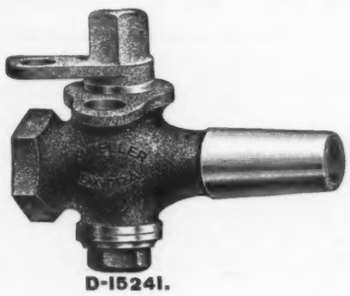

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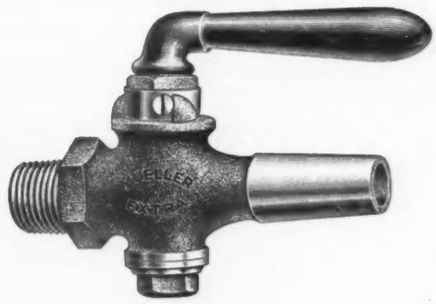

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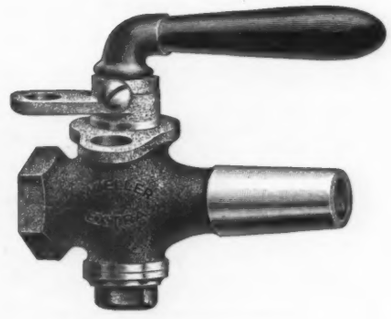

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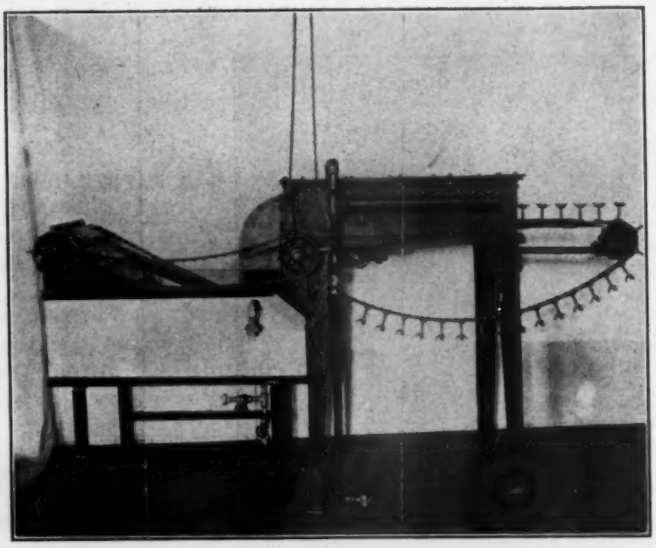

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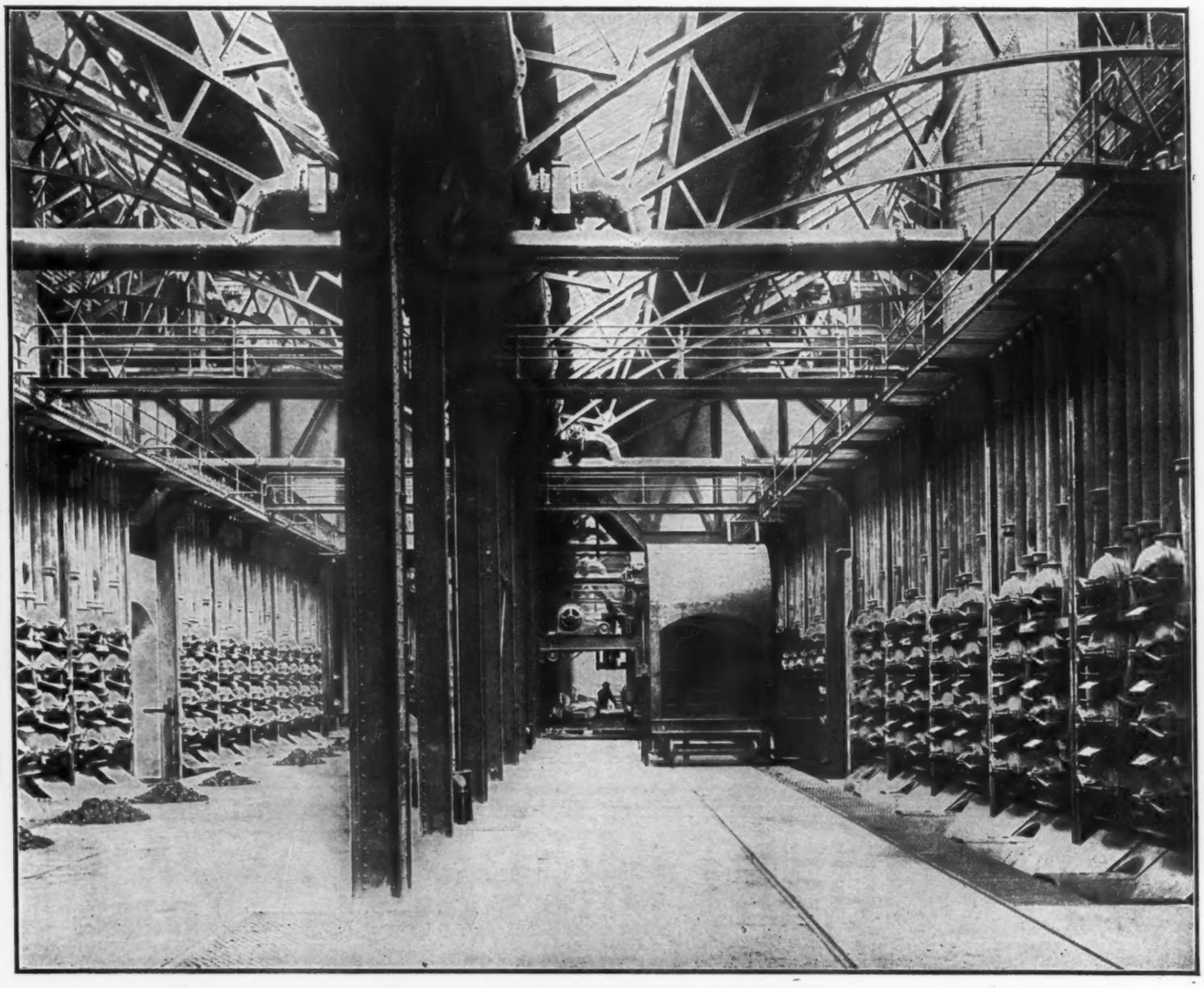

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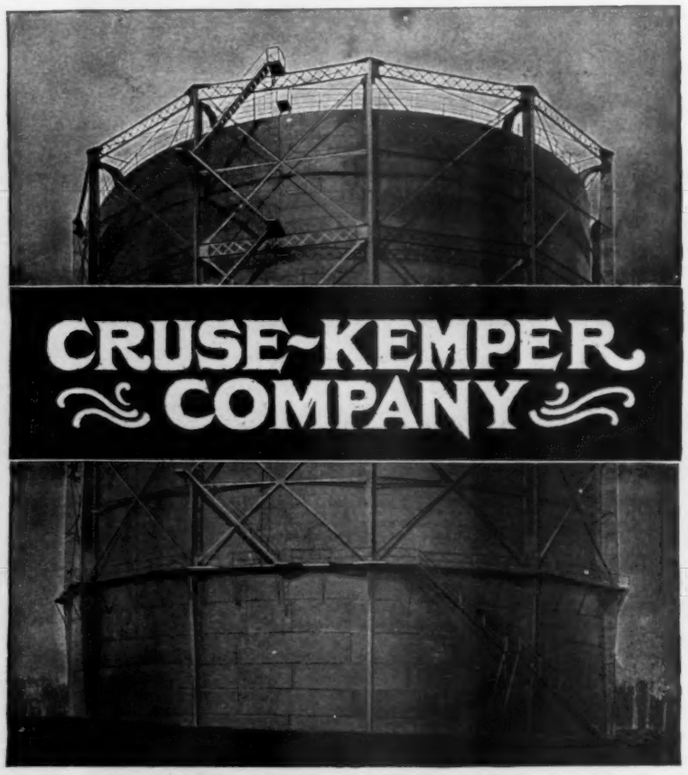

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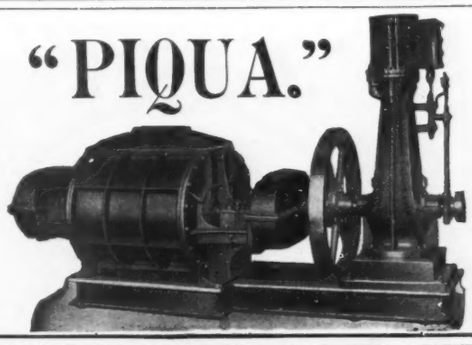

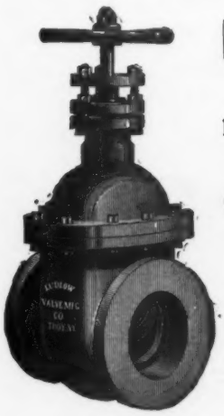

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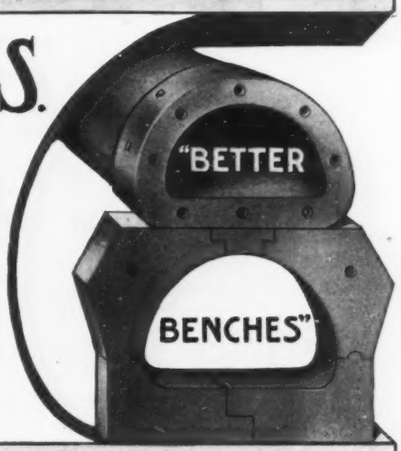

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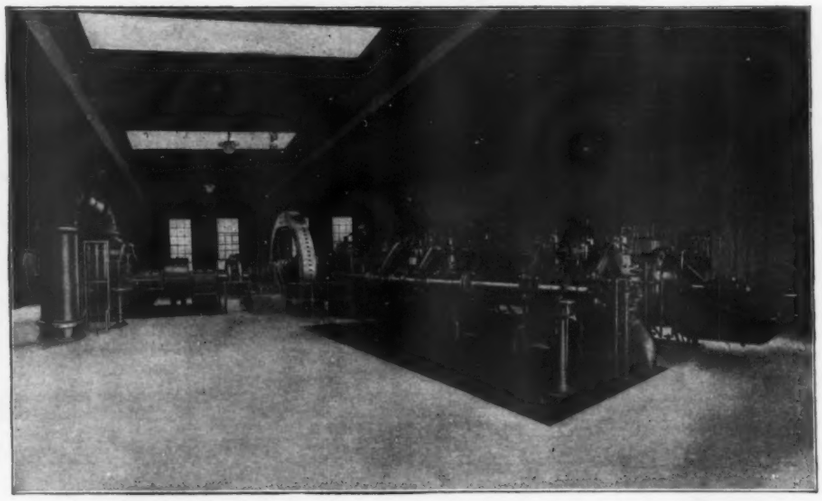

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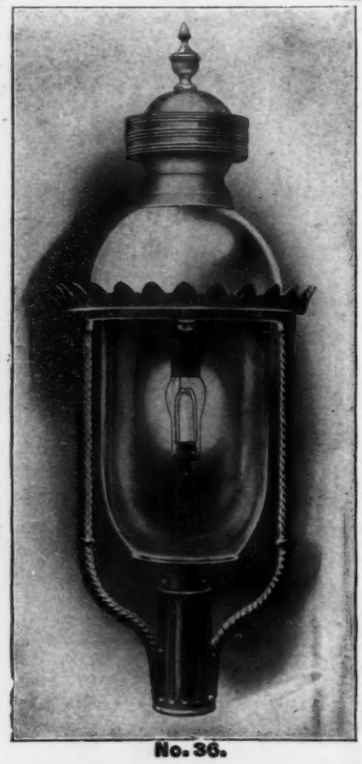

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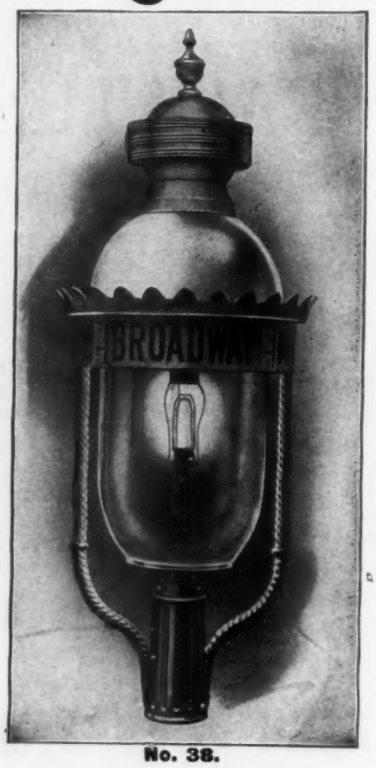

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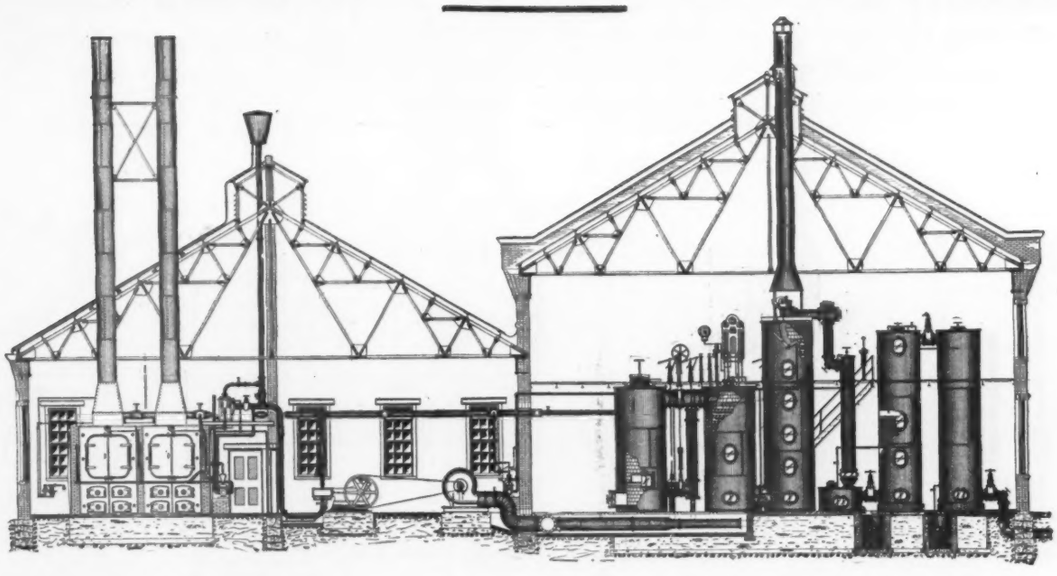

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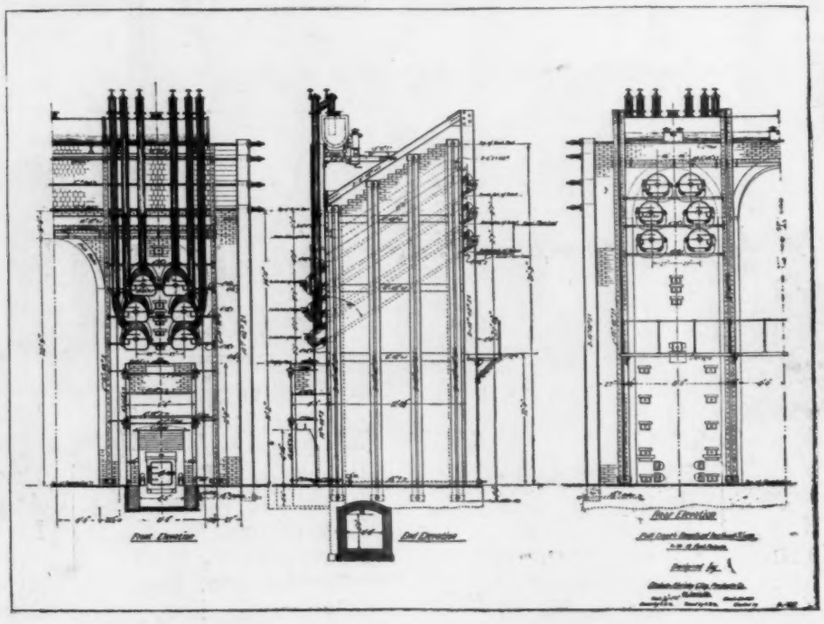

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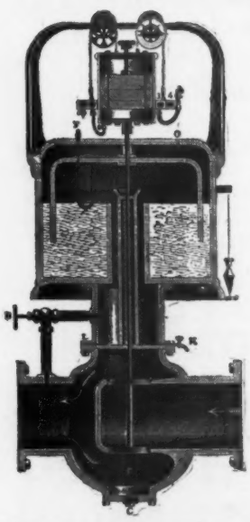

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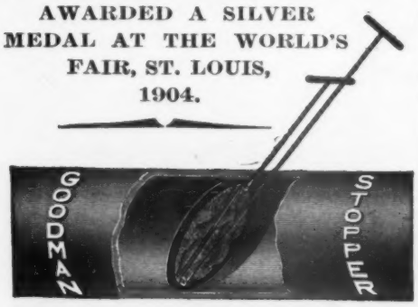

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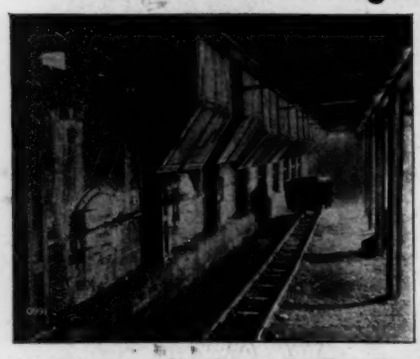

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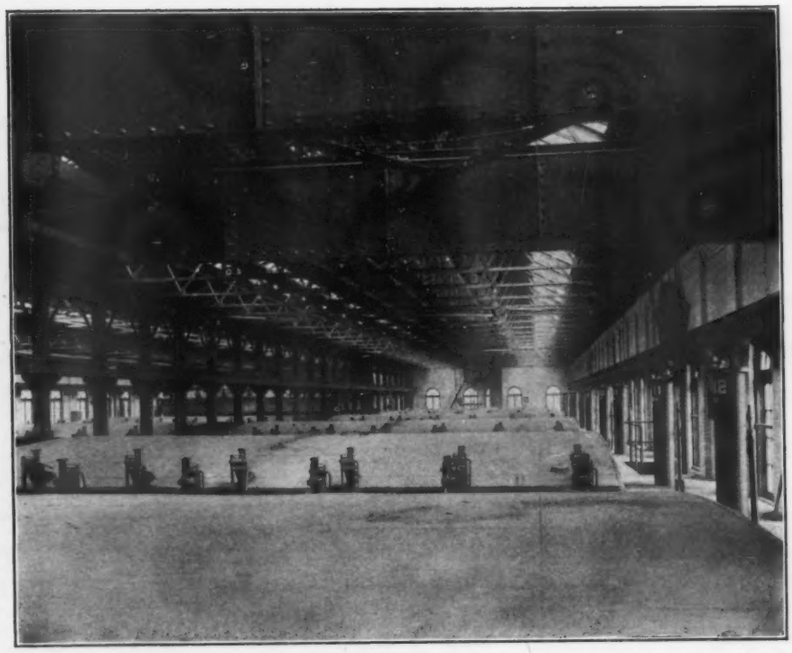

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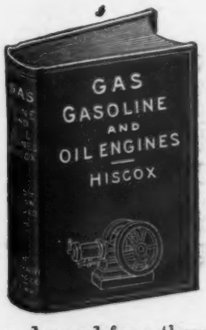

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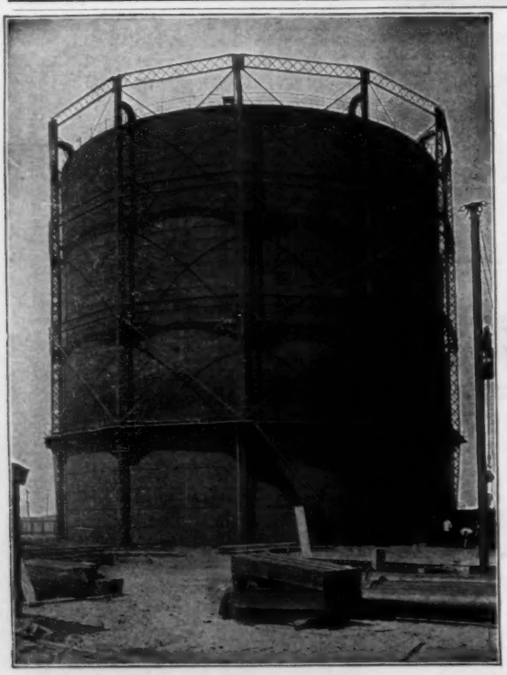

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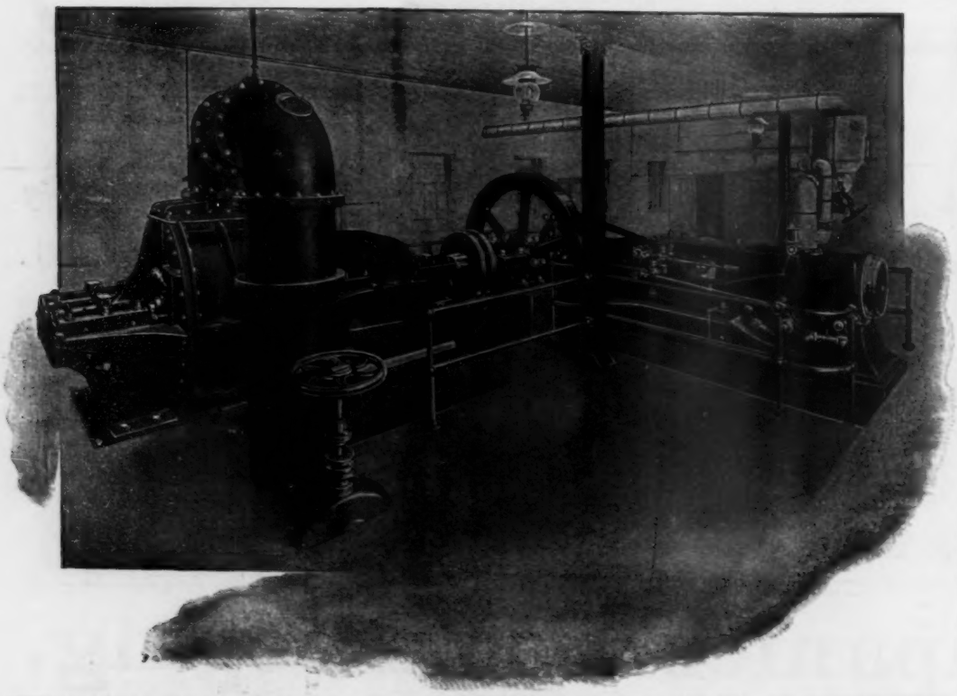

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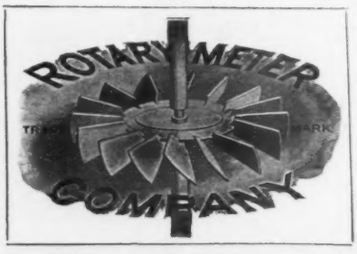

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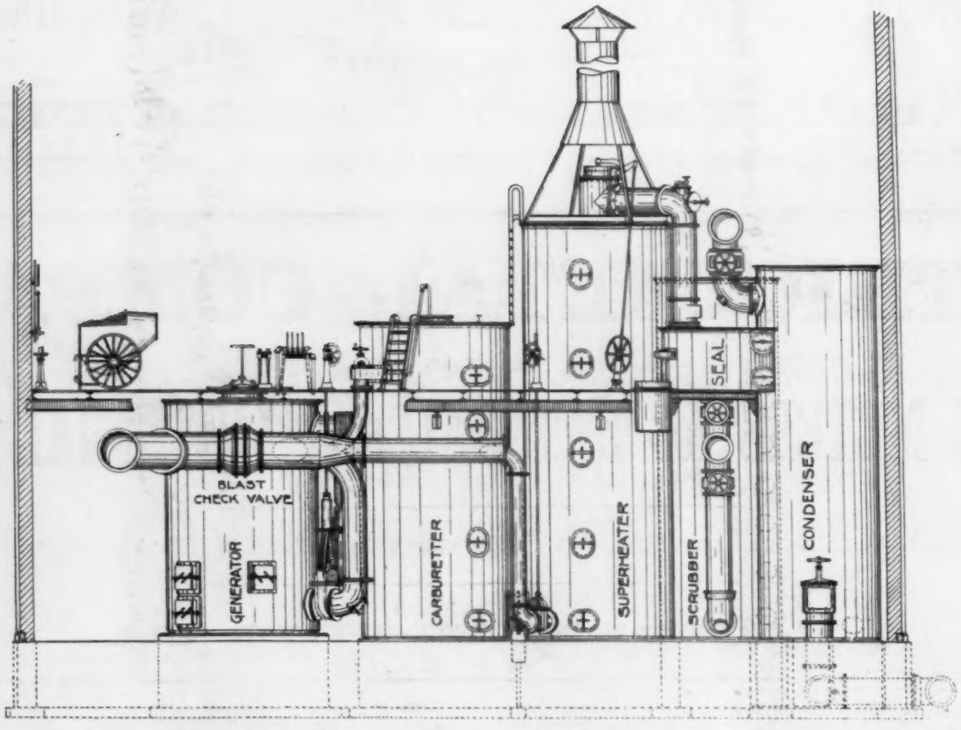

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